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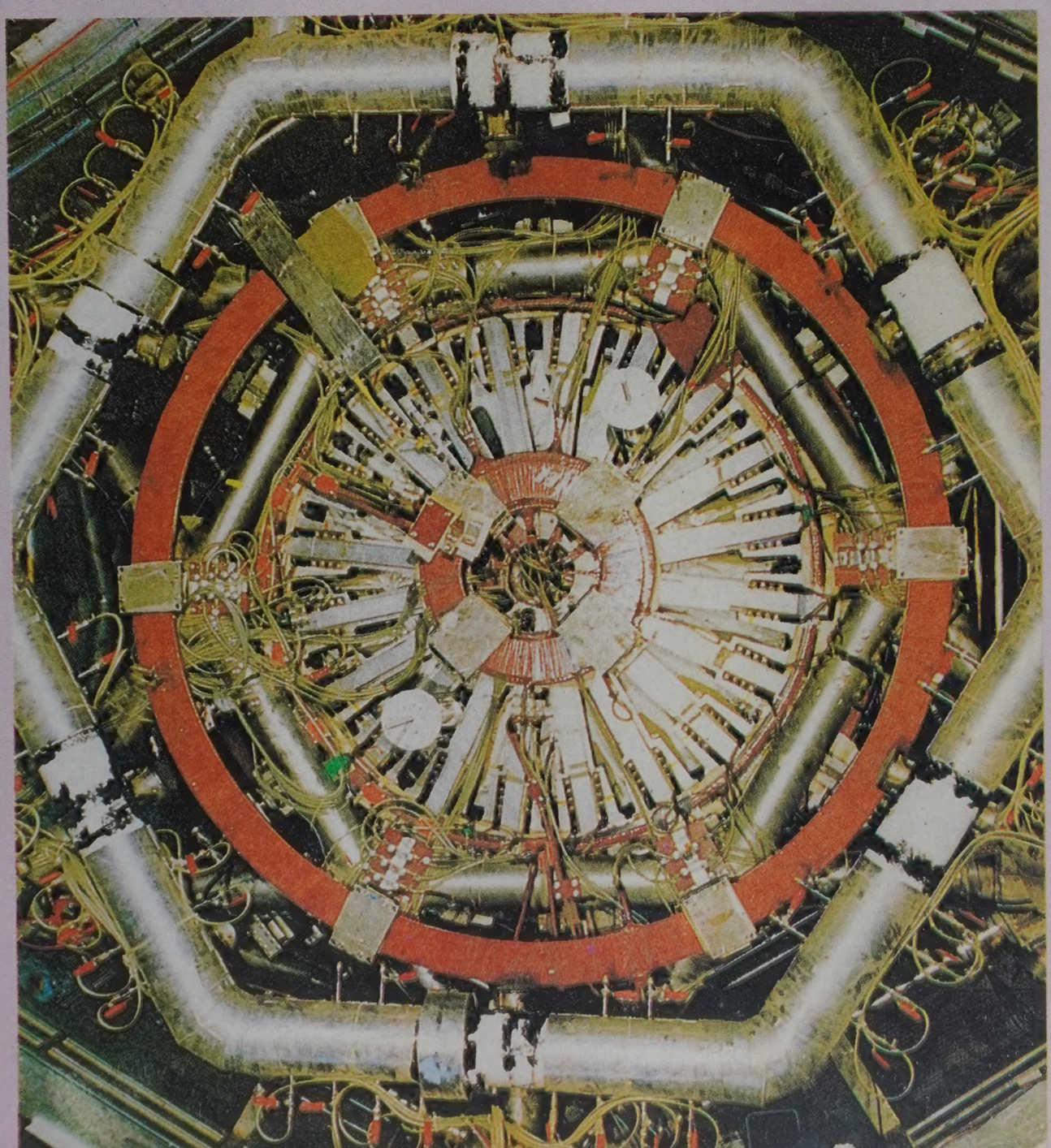

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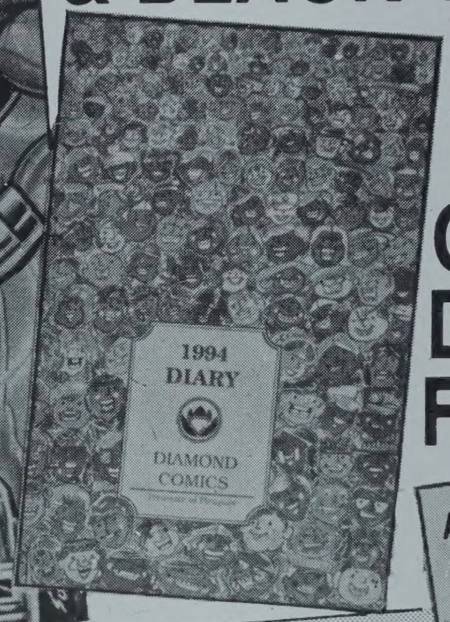

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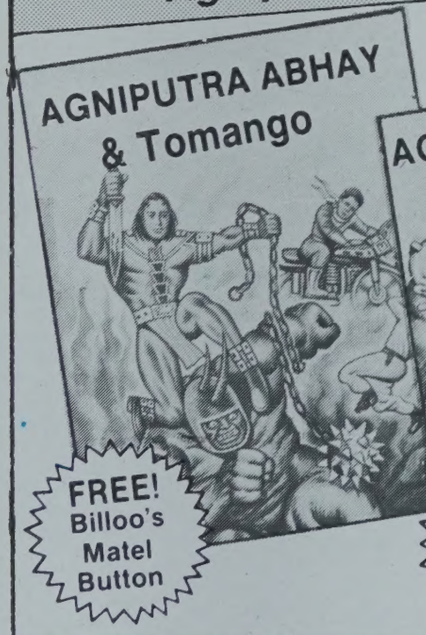

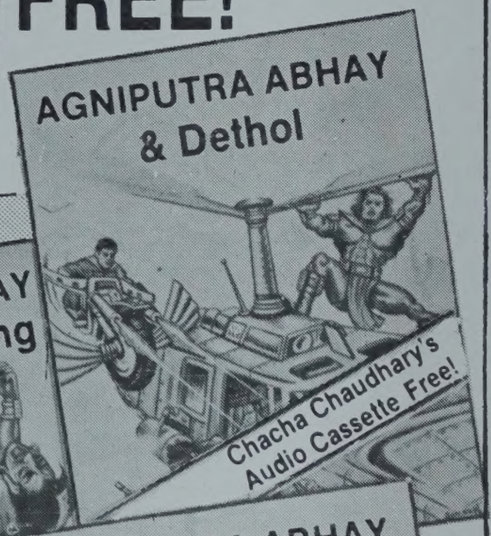

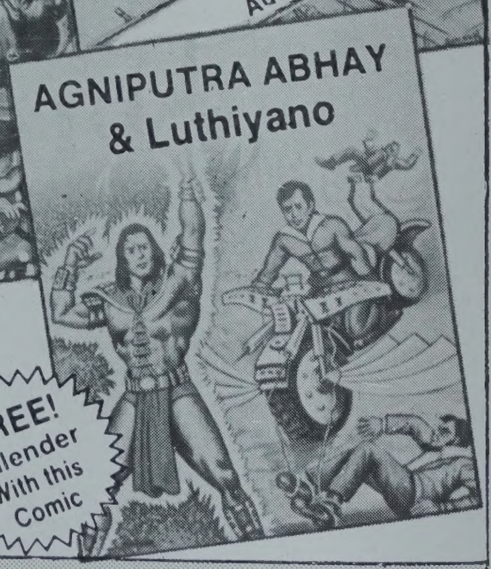

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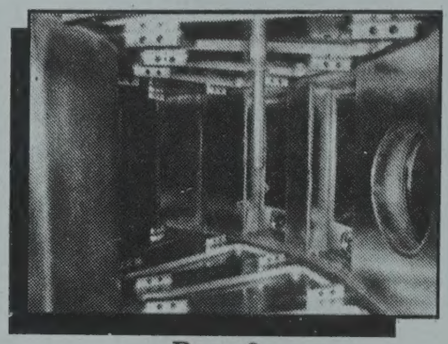

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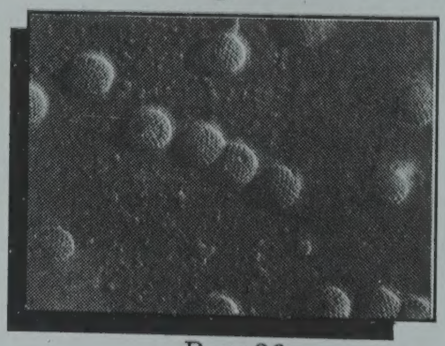

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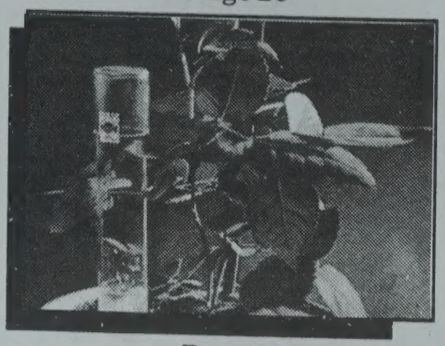

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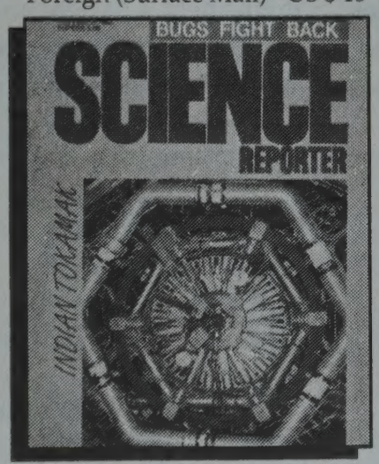

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Price Of Ignorance

EARTHQUAKES are not an uncommon natural phenomena. Scores of them are recorded every day by seismographs spread across the globe. Majority of them however, go unnoticed, being too faint to be felt or occurring in remote, uninhabited places. When a quake hits a populated area, the toll can be heavy as was witnessed recently in Maharashtra.

But earthquakes, even when strong, need not always kill. While the death toll in Maharashtra has been put at over 20,000, a quake of similar intensity that struck San Jose, California in 1987 did not cost a single human life, although physical damage amounted to some $ 10 million. Similar disparities in quake toll have also been seen elsewhere, especially between quake-hit areas located in developed and developing countries. The toll in poorer countries are invariably much higher.

One need not look far to find out the reason for this disparity. At the root of such tragedies lies the almost total lack of safety awareness among the general populace and poverty which forces people to live in unsafe dwellings. In the villages worst affected by the recent quake in Maharashtra, for example, most of the deaths were caused by falling boulders that formed the walls of the dwellings held together by no more than just plain earth (adobe). Such building practices are not uncommon, but given the continuous seismic activity in the region over the past one year or so, it is surprising that local residents were not warned of the likely consequence of a major quake or given adequate guidance about possible precautionary measures such as using simple reinforcements or safer sleeping places, for example.

Earthquakes may not be predictable today, but technology is available, which is not very expensive, that if adopted can prevent calamities of such magnitude in future. Lack of preparedness and ignorance need not be paid for in terms of human lives.

Reactions

Matter of Brains

Apropos of letter from Mr.A. Kandpal, Vadodara, in the 'Reactions' column (*SR*, September 1993) on"A Matter of Brains". I feel Mr. Kandpal's encomium for the technocrats and their 'super', 'first-rate' brains is far too overestimated. May I ask him how on earth he believes that those who are not in the medical or engineering professions, have second or third rate brains. I think good administrators should have a good deal of practical intelligence or 'tacit knowledge', loosely defined as "all the important things they never teach you in school" such as "spotting who's in charge", or being able to read a person's gestures or knowing how to get your work done. These are in fact the sort of things on which success in life often depends, more than on explicit information of the sort we are fed in educational institutions. Mere technical knowledge won't do. One must be familiar with the human faculties also, to become an efficient administrator. We need to accept the fact that no amount of technological or analytical brilliance (what is normally seen as intelligence) can stave off the spectre of the human meatpie—not unless it is combined with a deep understanding of human beings themselves..

Rajiv R. Ahlawat
Rohtak (Haryana)

Scientists

I am a regular reader of *S.R.* The life, history and works of different scientists published in *S.R.* is very interesting. I refer to the article (*SR*, September 1993) 'Unsung Men of Science' *Debendra Mohan Bose - A silent scientist* by Hasan Jawaid Khan. I suggest that articles on the life of Sir C.V. Raman, Sir J.C. Bose, Prof. C.N.R. Rao be published in the forthcoming issues. The magazine is useful for the men of science and students of both undergraduate and postgraduate classes.

J.C. Mohanty
Puri (Orissa)

Greening The Red Planet

Prima facie, the idea of making Mars habitable, as proposed by NASA scientists and mentioned in the article **Return to Mars** by Biman Basu (*SR*, August 1993), appears alluring. However, the grandiose design of releasing chlorofluorocarbon in the atmosphere, in the first stage and subsequently using genetically engineered plants, requires a more exhaustive and cautious approach. It should be remembered that soace is radically different from all other environments familiar to man, both in terms of physical properties and in the nature of equipments required to explore and utilize it. Also, it is important that the biosphere of the planet be preserved for science in its pristine state. Complete sterilization of terrestrial micro-organisms is impossible. The possibility of its propagating rapidly or acquiring new pathogenic or other harmful properties in new ecological conditions cannot be ruled out.

S.K. Gurtu
Delhi

Floods

The article **Why Floods Recur** by Biman Basu *(SR*, September 1993) highlights the occurrence of floods and possible measures to combat these. In fact, his suggestions to implement 'Flood Plain Zoning Bill", though quite appropriate at the present juncture, are difficult to practise. Unfortunately all densely populated areas including important cities in the country are located either on the river banks or on the deltaic plains. When the inhabitants of the catchments whose lands are submerged during execution of irrigation projects are up in arms it would simply be a thankless job to take preventive measure.

But to ameliorate the problems to a smaller extent, soil conservation measures in the upper catchments should be given importance by the Government. This would not only arrest silting of reservoirs and rivers but certainly would reduce flood havocs down stream.

R.C. Nayak
Kharagpur (West Bengal)

Fine Facts

The story on the Automatic Exchanges developed in India (*SR*, September 1993) reflects the facts correctly and is written in such a way that will make every Indian proud about the development of the indigenous technology by the C-DoT.

N. Vittal
Chairman, Telecom Commission

Zip-Rap

The article **100 Years of Zippers** by G.S. Rautela (*SR*, September 1993) made very interesting reading and reminded me of a situation in emergency medical practice which I would like to share with the readers. It might help a patient and bail out a doctor from a difficult situation with an easy solution.

A young man was once brought to the hospital emergency. In an urgency to micturate and to relieve himself he had snapped open the zip of this pant suddenly. As he was not wearing anything under the slider of the zip caught the loose skin of his penis. He could not move the slider back as it was painful and was

Reactions

compelled to cut the rest portion of the zipper and come to the hospital.

I was not prepared to face such a tricky situation. I first thought of a minor surgical operation under local anaesthesia to remove the slider, but that would have damaged the skin of the penis and could cause scarring. Then, I closely looked at the slider and realised that the top connecting portion is very fragile. I took an ampoule-cutting saw, cut the upper end from sides and in less than a minute, the slider came out in two pieces. The man was saved of an operation. Also, the skin of the penis was almost undamaged.

Dr. D.K. Mahapatra
Bilaspur, (M.P)

'Not that Kadamba'

The article on Kadamba by B.S. Somashekhar (*SR*, September 1993) was informative as well as interesting. But an error appears to have crept in. He says, "In the yester years people associated Lord Krishna with Kadamba" which is erroneous. The Kadamba associated with Shri Krishna is *Mytragyna parriflora* and not *Anthocephalus Kadamba*. *Mytragyna* is also known as `Kaim', a corruption of the word `Kadamba'. It is also called `Phaldu' in some regions. It is similar to Haldu (*Adina cardifolic*). All the three species belong to the family Rubeaceae. The head of the *Mitragyna* flowers is much smaller than that of *Anthocephalus*. Mytragyna is a xerophytic species still growing in and around Vrindaban and Mathura. It is only *Mytragyna* that can stand the thrust and pull of the swings (Jhula) so frequently associated with the Gopas and Gopis and Shri Krishna. *Anthocephalus* is too tender and fragile to support the *jhulas*.

Jagannath Tripathi
Gonda (U.P)

Valuable Information

Thanks for publishing the information on Taxol in **Quanta** (*SR*, July 1993). That information will certainly kindle the Indian scientists to work on biotechnology facets of *Taxomyces andreanae*.

S.V.S. Subrahmanayam
Bombay (Maharashtra)

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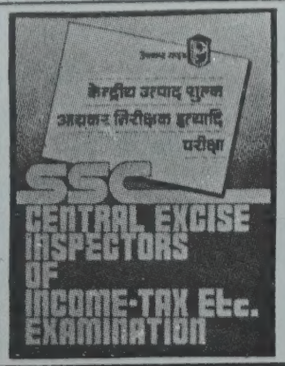

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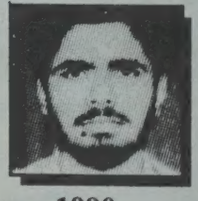

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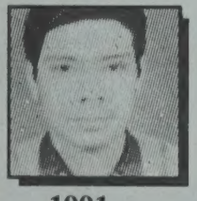

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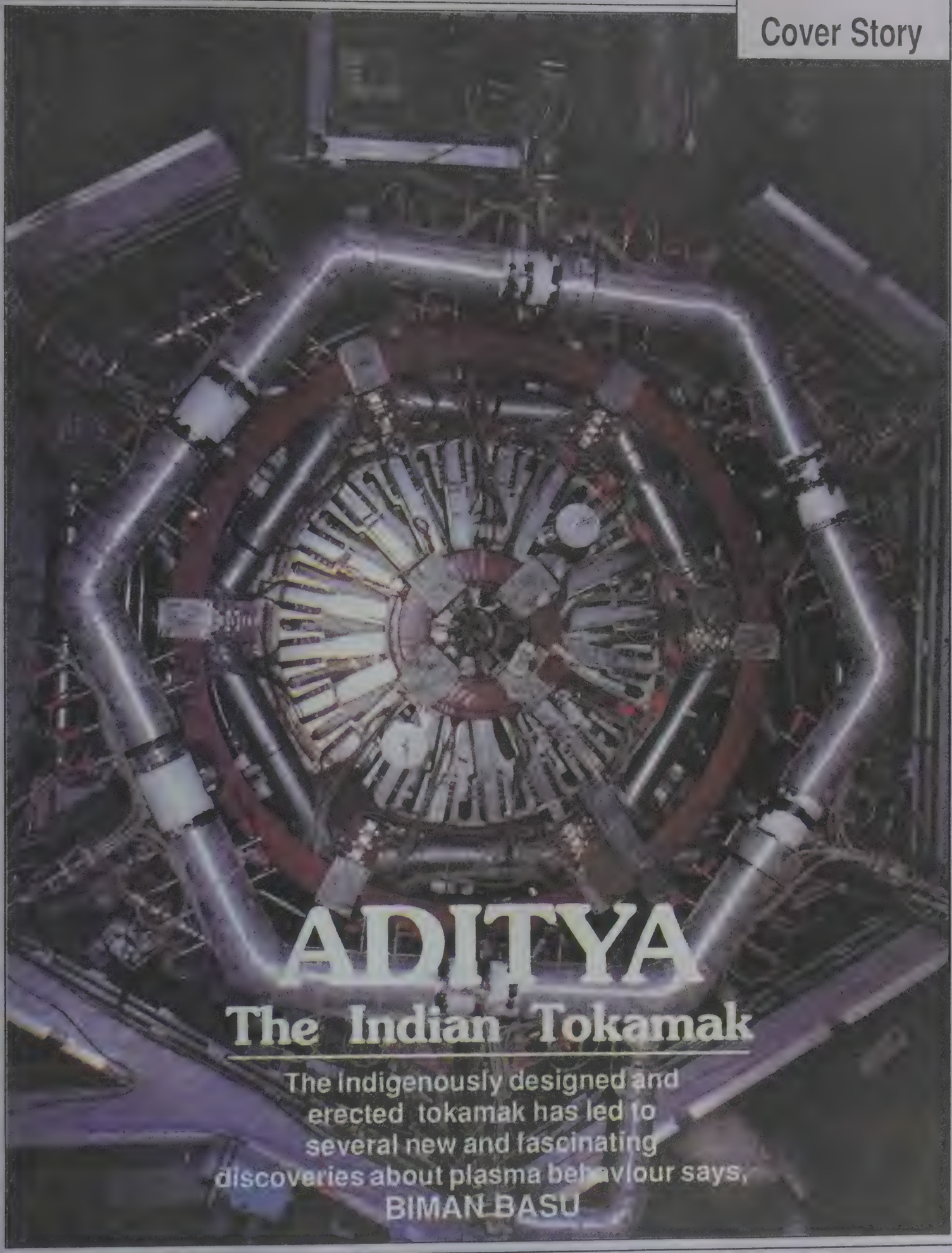


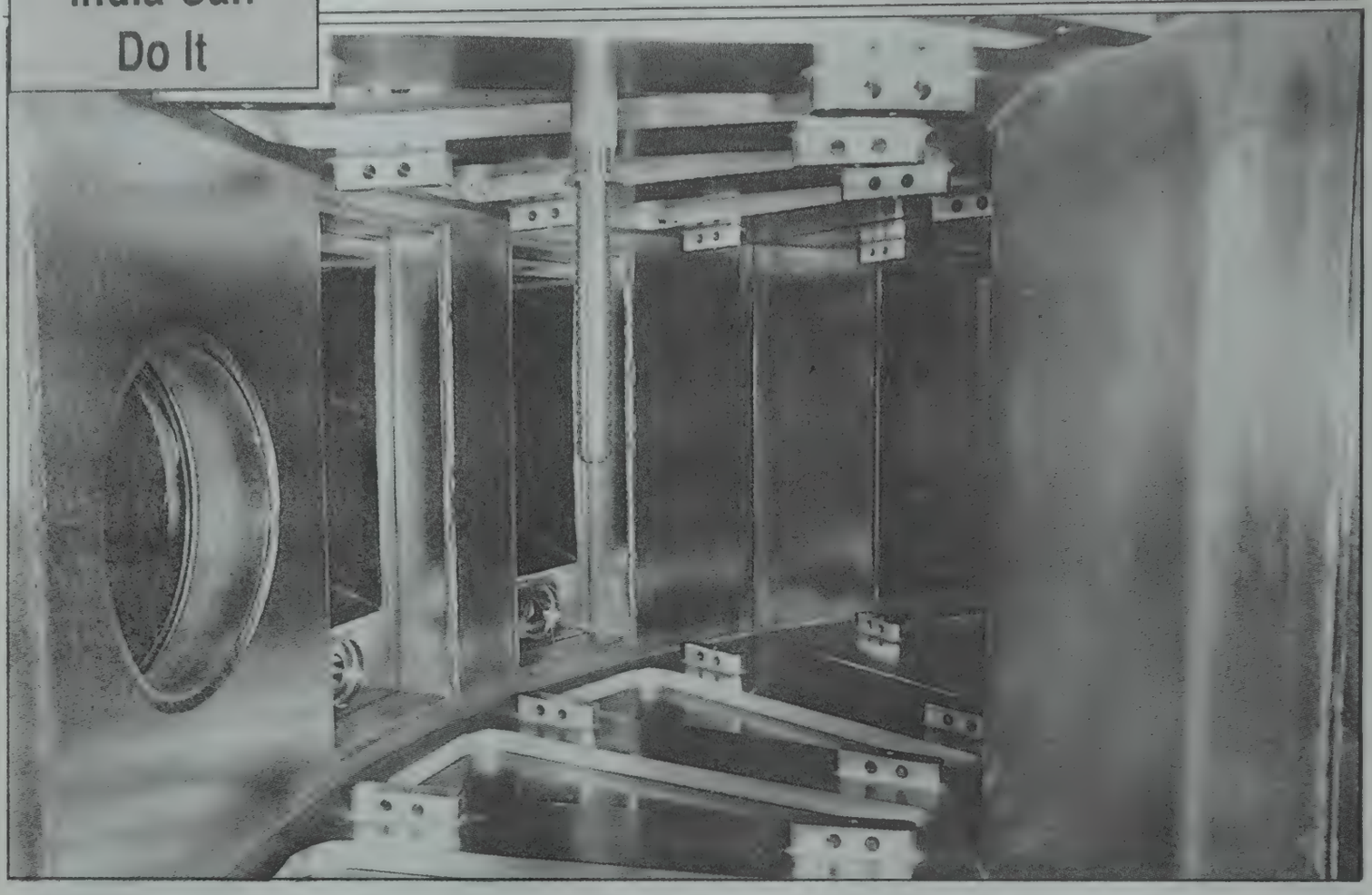
ADITYA

The Indian Tokamak

The indigenously designed and erected tokamak has led to several new and fascinating discoveries about plasma behaviour says,

BIMAN BASU

India Can Do It

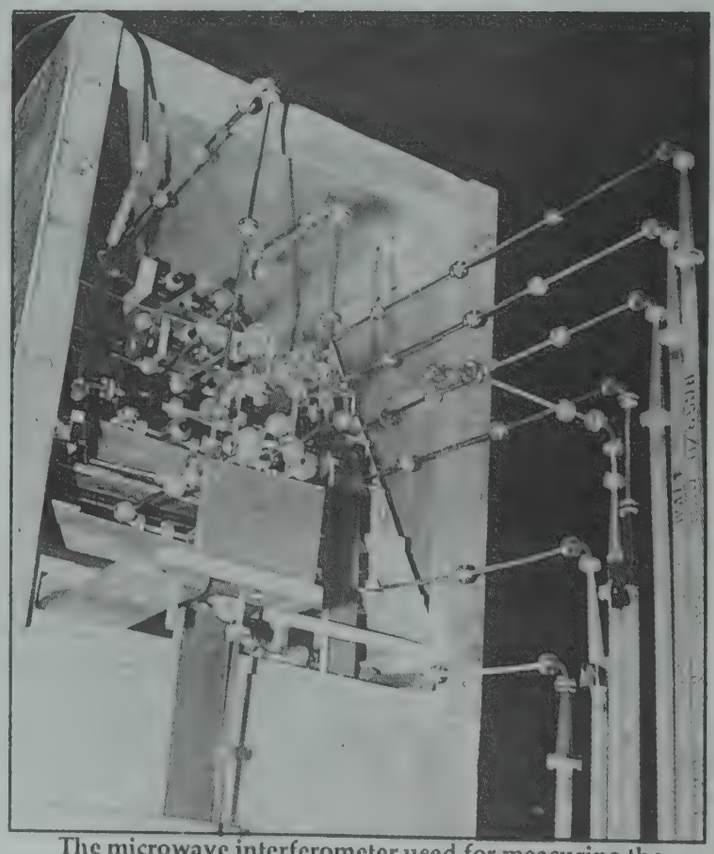


Inside view of the vacuum vessel of Aditya

WHAT is common between an unruly mob outside a football stadium and the ring of hot plasma inside a tokamak? Any plasma physicist will give you the answer: Both behave unpredictably and are difficult to control. In fact, these two factors still remain the main hurdles in the way of viable fusion power.

It was the promise of unlimited clean power that controlled nuclear fusion held for the future which led many of the developed nations in the west to invest heavily in fusion research in the 1960s and '70s. But success has been elusive. The best that could be achieved so far was the production of 1.7 megawatts of power for one second in the Joint European Torus (JET) at Oxfordshire in England in November 1991, but the output was not even 10% of that needed to sustain the fusion process. Fusion power still appears to be a distant dream. Nonetheless, fusion research over the years has provided physicists with new insights into the world of plasmas which, incidentally, is believed to constitute almost 90 per cent of the matter in the universe.

It was Hans Bethe who first proposed the idea of nuclear fusion as the source of energy in the core of stars including our sun. The first demonstration of the awesome power of fusion came with the hydrogen bomb. But



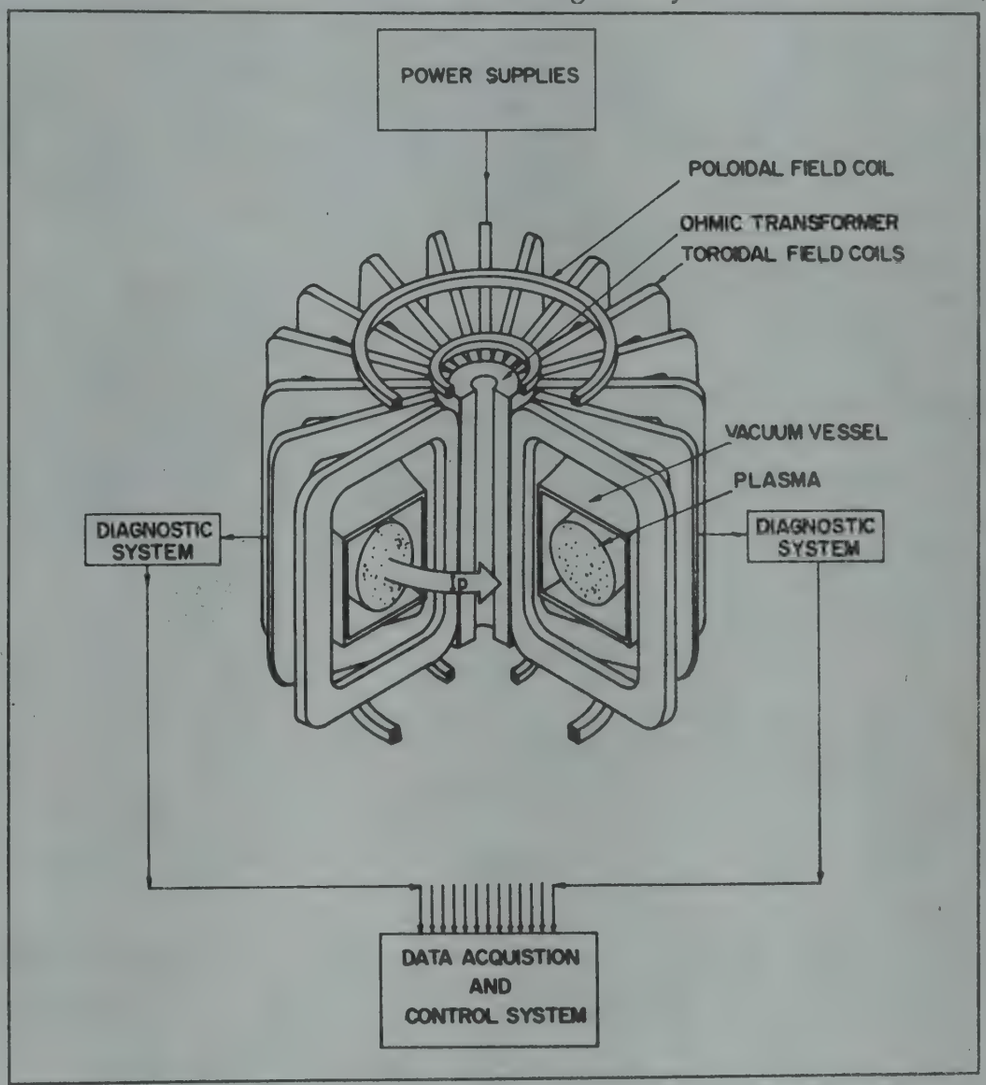
The microwave interferometer used for measuring the plasma density

unlike fission, controlled nuclear fusion was a different cup of tea. Fusion needed extremely high temperatures, of the order of a few hundred million degrees celsius, which was not only difficult to achieve in the lab, but even if it could be achieved no material was available that could hold matter at such high temperatures. More importantly, since matter at such temperatures can only exist in a completely ionized state called plasma, its behaviour is extremely difficult to predict.

Says Dr. P.K. Kaw, Director of the Institute for Plasma Research, "A plasma is a classical many-body system with a large number of degrees of freedom. Its behaviour is dominated by collective phenomena arising due to long-range Coulomb force which urges groups of particles to move cooperatively. Furthermore, a plasma is typically born when violence is done to matter in some form, and is therefore characterized by large deviations from thermodynamic equilibrium." This state of affairs makes plasmas highly unstable, seething with turbulence and chaos. Containing such a wild beast within the confines of any reactor system was a Herculean task. But scientists are an ingenious lot. They found a way out by confining the hot plasma within a shell of strong magnetic fields created around the plasma.

Of the various schemes tried out for magnetic confinement of plasma, the one which has achieved most success and received most attention is the 'tokamak'. It is a toroidal magnetic trap and gets its name from the Russian words *toroid, kamera* (chamber), *magnit* (magnet), and *katushka* (coil). The concept was first proposed by the Russian physicists Andrei Sakharov and Igor Tamm. But L.A. Artsimovich of the Kurchatov Institute, Moscow is usually considered to be the father of tokamak research.

A tokamak is a magnetic bottle in which the confining field is created by a combination of currents flowing in external coils and currents flowing in the plasma. The combined field lines are helical and form so-called 'magnetic' surfaces, that is, each line of force endlessly winds on a given surface and densely covers it. Charged particles moving freely along field lines are thus glued to the surfaces. Only collisional encounters make them step across and give rise to diffusion. The whole configuration consists of a bunch of nested surfaces (like onion peels) with the hottest plasma at the core in the centre. Plasma currents not only generate the confining fields but also lead to heating because of the finite resistance of the plasma (like a toaster is heated by passing a current through a filament).



The cut-away-section of a tokamak

Plasma research in India began in the 1960s as part of the space programme, but it involved no concrete programme of plasma physics. That came much later. In 1982, at the initiative of a group of young physicists working in the USA, a major activity in the field was initiated at the Physical Research Laboratory, Ahmedabad, which later led to the establishment of the Institute for Plasma Research in Gandhinagar, in October 1986. One of the landmark achievements of this fledging institute has been the design, fabrication, erection and commissioning of the first indigenously built Indian tokamak, christened 'Aditya'. Commissioned in September 1989, it can generate plasmas of temperatures up to 5 million degrees. While the temperature is not sufficient to trigger fusion, experiments carried out with Aditya have led to several new and fascinating discoveries about plasma behaviour.

India Can Do It

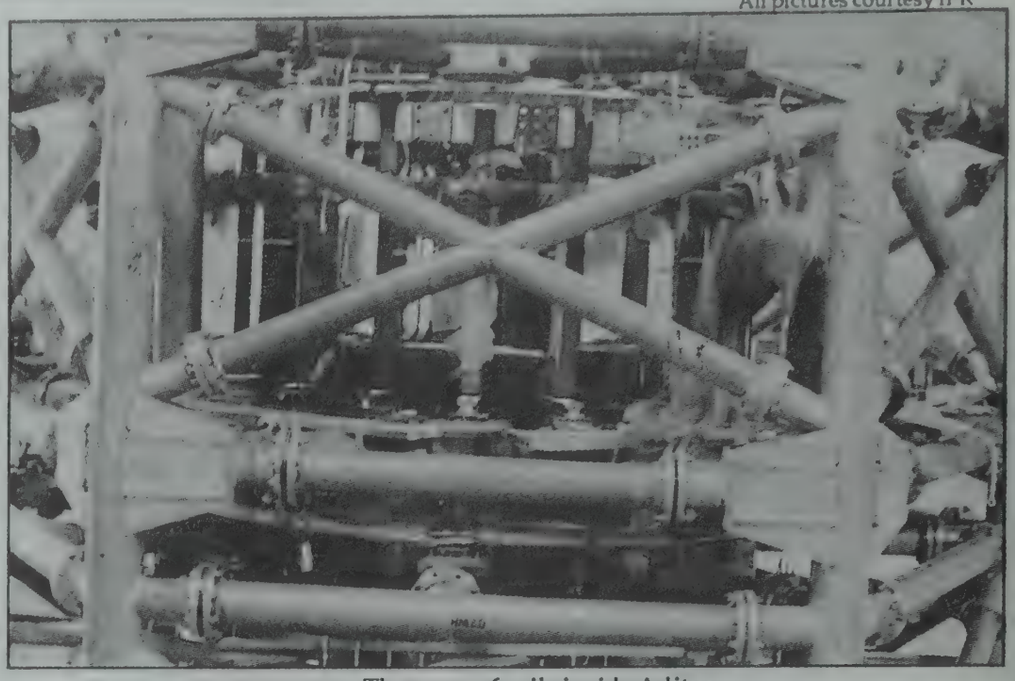
Aditya — a panoramic view

"The basic purpose of Aditya," says A. Sen of IPR, "is to provide fundamental information on plasma equillibrium, stability and confinement. To meet these objectives, "high emphasis is placed on the diagnostics of the plasma." Since the entire sequence of plasma production, confinement and heating is a pulsed event lasting just a few seconds, the entire operation is computer controlled. Most of the diagnostic probes employed in Aditya, including sophisticated signal handling electronics and instrumentation have been designed

in-house.

The design, fabrication, erection, and commissioning of Aditya posed a major technological challenge to Indian scientists and the Indian industry. The successful completion of the project was achieved, says Kaw, with the involvement of various agencies and organizations. The basic conceptual design was carried out by the IPR scientists and engineers in close collaboration with Tata Consulting Engineers, Bombay. Special advice was also provided by scientists from BARC, VSSC and SAC. The various

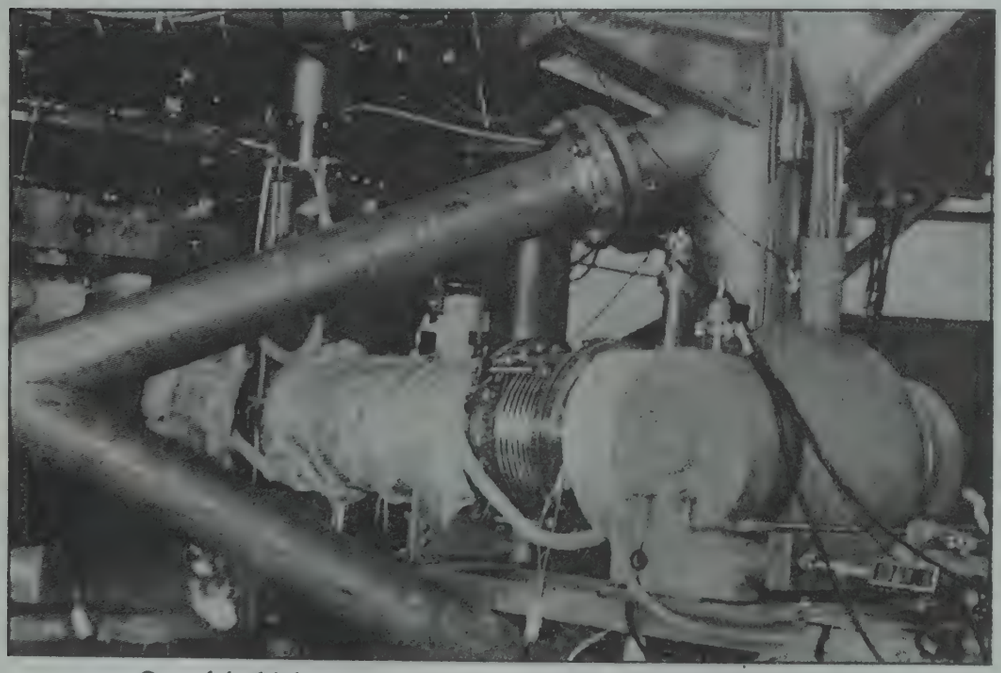
All pictures courtesy IPR



The maze of coils inside Aditya

subsystems were fabricated at IPR and at various industries including BHEL, Bhopal; Larsen & Toubro, Bombay; Godrej, Bombay; NGEF, Bangalore; and Hindustan Brown Bovery, Baroda.

Aditya employs three principal sets of magnetic field coils, the toroidal field (TF) coils, the ohmic transformer (TR) coils, and the vertical field (BV) coils. The TF coils produce the main toroidal field, the ohmic transformer formed by TR coils produces the transformer flux required to produce the plasma and drive current through it, and the BV coils provide the vertical or equilibrium field that maintains plasma in equilibrium position during the course of a discharge. In addition, a set of feedback coils are used to control the plasma position. These large-area, high-field coils, have been designed and fabricated indigenously. Enormous electromagnetic forces appear on the magnetic field coils because of the large currents flowing through them and the plasma. The coils are therefore restrained by a carefully designed mechanical structure, which also provides an independent support for the vacuum vessel.



One of the high power turbo pumps used in Aditya's vacuum vessel

The vacuum system of Aditya includes one of the largest ultra-high vacuum (UHV) vessel (capable of reaching an ultimate vacuum of better than 10^{-9} torr), designed and built in India. The vacuum vessel is a torus of major radius 75 cm with a square cross-section of side 60 cm. The vacuum vessel is mainly pumped by two turbo-molecular pumps each having a pumping capacity of 2000 litres per second for air and backed by two rotary pumps of 60 cubic meters per hour pumping speed, and two cryopumps, each having a pumping capacity of 10,000 litres for water vapour and condensible hydrocarbon. To ensure clean surface conditions of the vacuum vessels as required for reproducible plasma discharges, a large number of techniques, developed in-house, have been used.

"The primary goal of starting tokamak research in India," says Sen, " is to pursue a vigorous basic research programme that will address the many physics issues of high-temperature magnetically confined plasmas in general and those of tokamaks in particular. An additional mandate is technological development — to create indigenous expertise in the construction of experimental devices for hot plasmas and to build an infrastructure within the country that will anticipate, critically evaluate and implement fusion technology if and when it is proven viable.

"As the country`s first indigenously built tokamak", says Sen, "Aditya has been a rich source of learning experience — both technological and scientific. With its first novel results on edge turbulence it has already made its scientific impact in the world fusion research programme. If the present experiments are any indication, there is good reason to hope that Aditya will continue to provide a happy hunting ground for exploring new ideas and gleaning new insights into the behaviour of tokamak plasmas." □

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DIWAKAR

PARIJATHA

The Flower From Heavens

B. S. SOMASHEKHAR

A walk early every morning is my routine. I see some persons busy sweeping and watering their courtyards. There are newspaper boys and milk vendors brisky pedalling their way and people running and jogging. Amidst such routine mornings I sometimes I come across events which make the day memorable. One such pleasant morning was clad with a mild refreshing breeze. I was passing by my neighbour's house and found his three year old daughter busy picking something from the ground. Surprised to see her up so early, I peeped in to check what she was doing. As I was stepping in, she greeted. "Good morning uncle !". She was only picking some flowers from the ground. As I went near her, she poured into my hands fresh, soft, sweet scented flowers pure white and fragrant like jasmine. For a moment I felt the softness of flowers were equally tender as her young cheeks and fingers. "Take home some flowers, Uncle", she said. I gave up my walk and helped her in collecting the fallen flowers from the ground. "Pick them up carefully Uncle, otherwise they get hurt, you know", she continued. Her innocence and the flowers made that morning a memorable one.

These flowers which we picked up from the ground were of *Parijatha*, which is well known throughout the country. Yes, the same *parijatha* which appears in *Mahabharata* where, it is said, Lord Krishna once brought this plant from the heavens to pacify Sathyabhama, one of his loving wives. Parijatha is one among the very few plants that have secured a lasting place in Indian culture and tradition. It is present in the homesteads throughout the country for its cute and attractive flowers.

Parijatha belongs to the family oleaceae in which another popular flower jasmine also finds home. Parijatha is botanically named *Nyctanthes arbor-tristis* while it has many attractive names in regional languages. In Hindi it is called *Kirsari* and *Har singar*; in Sanskrit its names are *Parijatha* and *Sephalika*. Its English and some regional Indian names also are also based on its resemblance to Jasmine. *Night Jasmine* and *Coral Jasmine* are its English names. *Pagada malle and Pavizha malli* are the names respectively in Telugu and Malayalam. In Kannada it is called *Parijatha* while *Manjhapu* is its Tamil name. It is popular as *Seoli, Jayaparvati*, and *Godokodiko* respectively in Bengal, Gujarat and Orissa.

Parijatha is a large bush, say, a small tree growing to a height of 4-5 m. It is a common member of deciduous forests of the country. It is also grown in gardens and homesteads for its cute and uniquely coloured flowers.

A grown up bush of Parijatha appears dull with its long drooping branches. Stem is erect and coarse. Leaves are egg shaped with a teethed margin, much like a wood saw. Leaves are also dull and often with white downy growth underside. To touch, they are stiff, hairy and rough. Out of such dull and unattractive plant arise the charming and elegant flowers. It is these flowers for which Parijatha is more prized. Parijatha flowers are exactly similar to those of Jasmine in size and shape. The only difference that has fetched parijatha a prime place is the striking colour contrast between the opened florets and the flowertube. The opened florets are pure white in colour while the tube is of deep orange. Florets resemble the blades of a fan and their tips are either turned to the right or to the left. One finds yellow to orange coloured anthers inside the tube. Had there been green colour in place of yellow, there would have been a perfect tricolour in the flower. Nevertheless, the flowers are so cute and pleasant with a mild fragrance that they immediately attract our attention.

Parijatha comes to bloom in the months of September and October; the blooming sometimes extends for the next few weeks too. Flowers appear in bunches at the tip of slender branches. Flowers open in the late evenings and hence the name *Night Jasmine*. Opened flowers fall to the ground early in the next morning. Usually either the fallen flowers are picked up from the ground or the flowers are made to fall by slightly shaking the tree and picked up. Parijatha flowers are hardly plucked directly from the plant.

Parijatha is equally prized for the range of medicinal properties it has. Almost every part of it has found a use in treating one or the other ailment. The bark finds a place for treating bone fracture, internal injuries and controlling discharges during pregnancy. Its leaf is used against many skin diseases and also against snake bite, fever, cough and hiccups. The flowers are also used against skin diseases and cough. Its seeds are used to treat scales on scalp. Bark also yields a tannin. The flowers yield a yellow dye. Dried leaves are used as sand paper by carpenters for scrubbing. Slender twigs are used to make baskets.

Growing a plant of parijatha is an easy task. It can be grown as a small bush in the home compounds throughout the country. It can even be grown in large cement pots. It does not require any special treatments. Seedlings are easily available with commercial nurseries. Procure one such healthy seedling. Prepare the large pot or the pit by filling soil, sand and manure in equal quantities. Plant the seedling during the rains. As the plant grows, prune the long running slender branches to give the plant a bushy appearance. After two years Parijatha will bloom its first flowers

Shri Somashekhar is a horticulturist. Address: 36, 'Niranjana Nilaya', 5th Cross, Opposite Government College, Tumkur-572102 (Karnataka)

SEEING THE BLOOD VESSELS

SURESH NADKARNI

BLOOD vessels cannot be visualised in ordinary X-rays. In such cases, the cavities in the organs are filled with a solution, called "contrast dye", which is opaque to X-rays. With a contrast dye in the organ, the walls of the organs and transparent stones in the cavities of these organs can therefore be easily visualised. This process is called opacification. When used for blood vessels, it is called `Angiography'.

Angiography is the study of the entire circulatory organ system, namely, the vessels of the head, neck, heart, the abdominal organs and peripheral vessels of hands and legs. It is used to study a block in the vessels. The narrowing of blood vessels can be diagnosed on angiography. For example, coronary or cerebral angiography may reveal narrowing of arteries of these organs. A block, causing paralysis, may be seen in the artery of the neck on angiography. An abnormal or abberant renal artery can be the cause of high blood pressure which can be easily diagnosed on angiography.

History of medical diagnostics tells us that angiography is one of the earliest techniques used in hospitals. In early days it was performed by radiologists (X-ray specialists). Specialists from other clinical branches of medicine were also consulted to corroborate the findings.

Angiography offers valuable information on the blood vessels so that appropriate drugs can be administered or surgery performed. The technique of film recording is based on the speed of the blood flow in the region being imaged. For example, 'Cine' angiography of upto 90 images/sec is used to record fast moving blood flow (90 cms/sec) in the heart; seriology up to 6 images/sec is used to record slow moving (1.6 cm/sec) blood flow in peripheral, abdominal and cerebral vessels.

In angiography, the movement of the contrast dye is viewed continuously under a fluoroscope ('screening' procedure) at low X-ray levels and then a series of radiographic (X-ray) pictures are taken intermittantly on a film.

TO ensure sufficient concentration of contrast dye in the blood flow being photographed, a catheter is introduced through a blood vessel in the arm or leg upon the point of interest. The insertion of the catheter is also viewed under a fluoroscope; it would result in a large dose of X-ray to the patient and doctor. To minimise this dosage the Image Intensifier is used to intensify the image thereby allowing significant reduction in X-ray dose levels; the image is picked up by a camera for display on a TV monitor. TV systems have been modified to improve the capability of viewing the heart from various angles without moving the patient. Thus cardioangiography has become a specialised field.

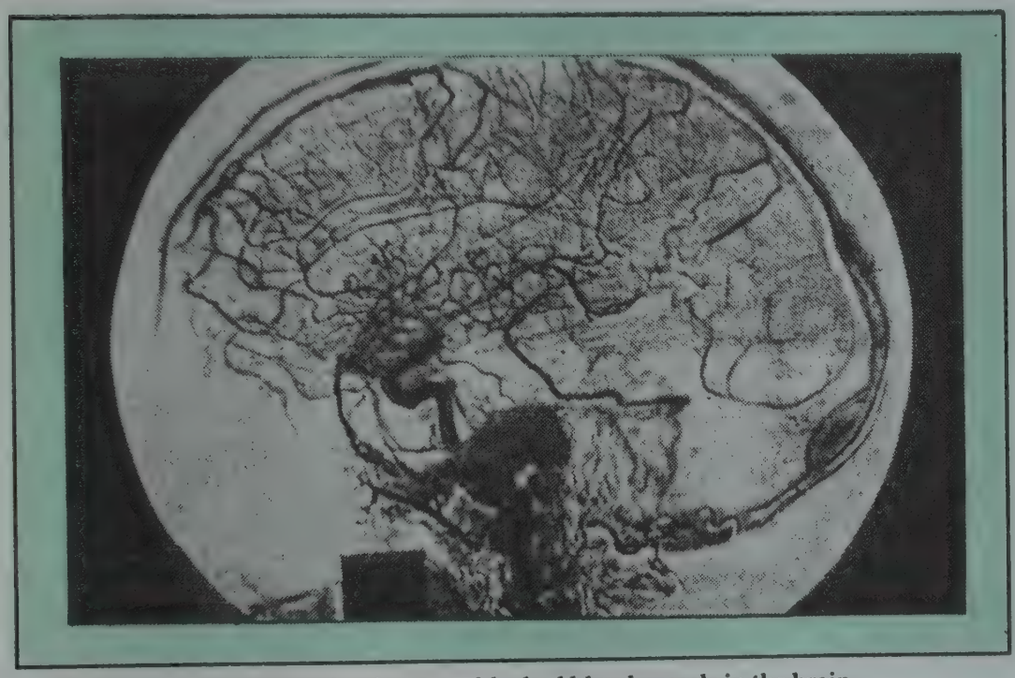
Similar equipment has been designed for other blood circulatory regions either to record X-ray directly on full size film or on a 100 mm film camera through a large intensifier.

Digitalisation of TV image signal in real time before and during the introduction of contrast dye is achieved by digital substraction angiography. Only blood vessels

could be serially seen with the help of this procedure, as entire background could be subtracted. Storage of digital images on magnetic disks and tapes save valuable record room space. This technique finds extensive applications in head, neck, abdominal and peripheral studies. DSA (Digital Subtraction Angiography) is also employed with certain technical limitations in the investigations of heart-vessels. DSA is very useful to Indian community at large on account of greater incidence of congenital and rheumatic heart diseases in the population.

OBSERVATION of arteries of brain by angiography is called 'cerebral angiography'. An iodinated compound is injected in one of the blood vessels of the brain, viz., carotid or vertebral artery. Carotid artery is more commonly used. In the pre-CT (Computer Tomography) era, cerebral angiogram was done to reveal any brain lesion. Now, with advent of CT and MRI (Magnetic Resonance Imaging), scope of cerebral angiography has been limited to vascular lesions, such as aneurysms or malformations of blood vessels in the brain.

Angiography is generally done under local anaesthesia unless the patient happens to be uncooperative or a child. Catheters are selectively guided into smaller branches of the arteries of the brain. DSA is done with intravenous (IVDSA) or intra arterial injections (IADSA). IVDSA is preferred, as a puncture in vein is not as invasive as a puncture in the artery (IADSA). Thickening of blood vessels of brain results in temporary attacks of complete/incomplete paralysis. This ailment is called TIA. However, if not diagnosed in time, TIA can be a warning signal of a major paralytic attack. A TIA can be diagnosed by IVDSA. However IVDSA cannot visualise all the blood vessels of the brain. In such circumstances IADSA is of immense value. Location of lesion, displacement of blood vessels, abnormal vascularility, tumours, etc., can be diagnosed on IADSA.



Angiography shows up blocked blood vessels in the brain

Angiography remains the most important diagnostic procedure to verify aneurysm, an abnormal widening of the blood vessel. The extent of aneurysm is also revealed by aurtic angiography (Aurta is the big artery coming from the heart. Arteriography reveals the irregular surface of the internal layer (intimal layer) of the arteries of the eyes as well lesions situated in it.

Aneurysms, precipitated on account of cardiovascular syphyllis, can also be delineated by angiography. The aortic valve also gets damaged in this disease. It does not close properly. Hence with every stroke of heartbeat the blood leaks through the aortic valve. The lesion is called 'Aortic regurgitation'. Before the advent of angiography the extent of leak was left to the clinical judgement of the doctor. Now with its aid, the judgement about the leak can be made. It helps to take corrective surgical measures, if necessary.

Angiography of lungs is called pulmonary angiography (PA). PA involves rapid injection of a radioopaque dye in pulmonary circulation. The contrast dye can be injected intravenously into one arm or into both arms simultaneously through a needle or a catheter. Direct injection into pulmonary artery is also achieved at times with the help of a catheter. On many occasions there is clotting of bloods in the vessels of lungs. These blood clots migrate in the form of emboli and get choked in narrow vessels. This mishap, called "thromboembolism", is invariably diagnosed on angiography. Congenital abnormalities, such as absence of pulmonary artery, are diagnosed with the help of PA. As mortality in PA is 3 per 1000, the decision to perform PA is taken carefully by doctors. The coronary (i.e., arteries of heart) angiography evaluates the extent of damage. The decision for `bypass surgery' is taken on this basis of this evaluation. The horizons and applications of angiography are widening every day.

Dr. Suresh Nadkarni is a practising physician. Address: Flat 38-39, 5th Floor, Municipal Building, Jobanputra Compound, Nana Chowk, Bombay-400 007

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.....Code 800
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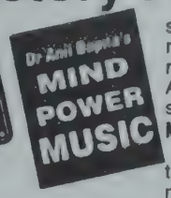

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  —Dr Anju Banthiya, MBBS, Bhopal, M.P.
- With your music, I start reading with more efficiency and more concentration. *—Tarun, Haryana*
- Your music improved my concentration. Now my mind works faster. *—Shaikh M-Faiyaz Faridmiya,Gujrat*
- Your music is very effective.
  —A. V. S. Satish, class XII student
- In two days, I have reduced my daily cigarette smoking by 10-15%. *—Cecil Chacko, Bombay*
- In two days, I have reduced my daily cigarette smoking by 10-15%. *—Cecil Chacko, Bombay*
- Dr Anil Bapna's research to increase the effectiveness of the mind by using music is appreciable..
  —Rajasthan Patrika Book/Music Review

Develop Strong Will Power.....(Code 260)

Success is not always easy. There are difficulties in the way to get success. Many people lack will power so they stop to continue their effort to achieve their goals/aims. This cassette programs you with strong will power. It helps you continue to try to achieve your aim/goals even in the time of difficulty.

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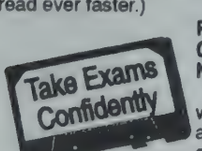

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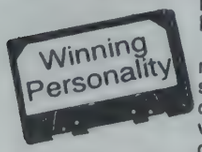

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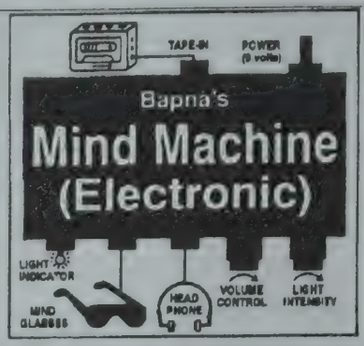

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This music contains Hidden-Messages™ which bypass your conscious mind and go directly to your subconscious mind, and change your behaviour. This is why the change and improvement with Mind Power Music is so easy and effortless. All you have to do is listen to Mind Power Music.

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WARNING: This music has powerful effects on your mind/brain. So, it is not for people with epilepsy, and anyone undergoing psychiatric or electro-therapy.

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Kolachala Sita Ramayya

Father Of Chematology

ACHALA JAIN S P K GUPTA

ON way to work that morning in wartime Moscow he had his third brush with the Nazi bomb and had survived only because it was a dud. Now returning home by the metro while changing trains at the junction he was caught in the passenger crush at the foot of the escalator. As he looked over men and women in front, their heads oscillated in a disorderly manner, so much like molecules in brownian motion, as they stepped on the escalator before riding up in a steady stream.

Kolachala Sita Ramayya, India-born and America-trained chemist working on efficient fuels and lubricants for Soviet tanks, had witnessed the scene many times before but the paradox struck him only now. He suddenly realised that what was happening before him is what happens in a lubricant: the interaction of mol-

ecules depends on their medium and in interacting they change the condition of their medium.

Like a sleepwalker he reached home and, without taking off his jacket, began to sketch on a sheet of paper the contours of what was shaping before his mind's eye: a lubricant is a special plastic (rheological) medium, and the interaction of its molecules (as well as the additive molecules) depends on the condition of the medium which itself gets changed as a result of their reaction.

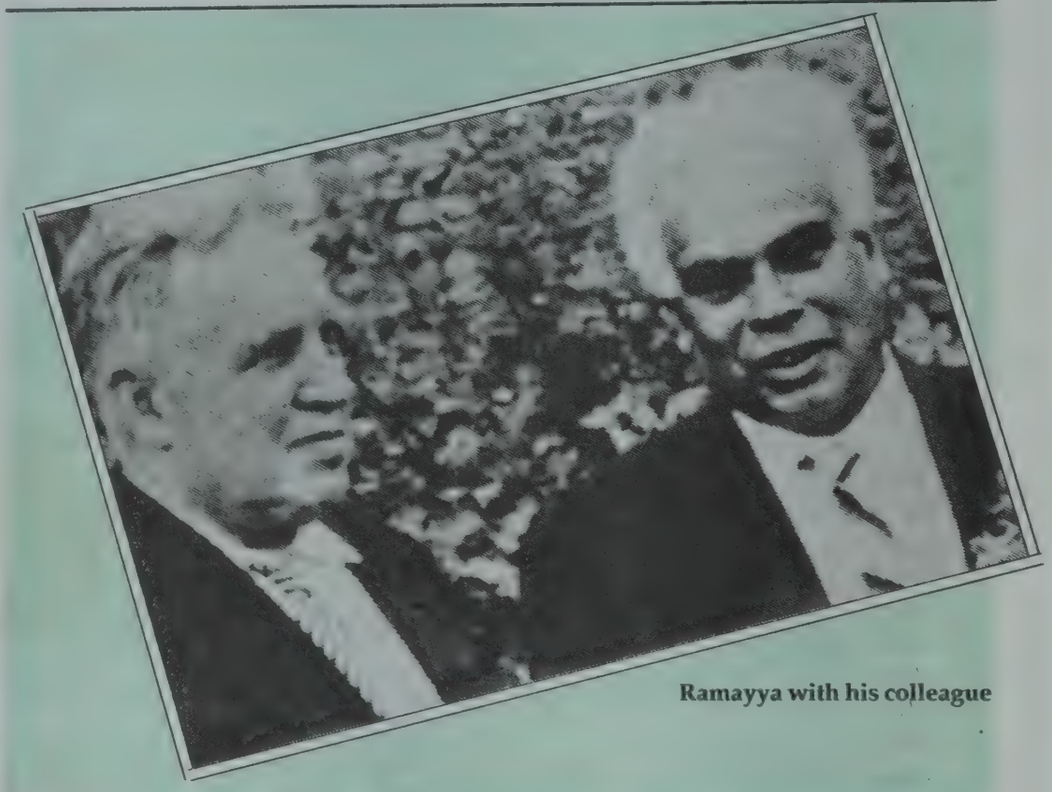
Earlier mathematical models had not served to picturise this. Research workers including himself had till then drawn on the concept of a lubricant as an abstract medium in which the molecules, like fish in an aquarium, moved colliding periodically. Everything was in fact the opposite: the medium was the property of molecules; it was like what molecules were in the process of interaction. For a clear understanding of the medium, a new approach was needed.

Ramayya now recalled an earlier close call. While he was on duty on the terrace of his apartment as air raid warden, he had calmly caught an incendiary bomb with a pair of tongs, drawn the sparkling thing along the terrace and cooly dropped it in the sandbox prepared in advance to meet just such a contingency. He had refused to accept the object as a weapon of death but watched those sparks as something related to lubricants, his professional preoccupation. But the thoughts the sparks had evoked got tangled amidst work and had been forgotten.

Now those thoughts came back. The sparks of the incendiary bomb were like sparks one got during autogenous welding, the sparks under the hammer of the blacksmith, the sprays of melting metal, the sparks from a volcanic eruption.

That's it! Ramayya saw in the flash what happens in the bowels of the earth. He visualised the boiling underground seas of magma. Before him suns were floating and from their insides emerged tongues of solar flares. He conceptualised a new state of matter which he called plastic. This concept gained credence as the plasma state after the achievement years later of controlled thermonuclear reaction.

From that discovery by Kolachala Sita Ramayya of the properties of the plastic medium developed a new branch of science —chematology, or the science of using combustible and lubricant material in technology; the chemistry of motor oils.



Ramayya with his colleague

The idea that lay dormant after he watched the sparking bomb and came to the surface while watching commuters step on to the metro escalator found both supporters and detractors but was soon accepted. The first practical results of the new approach followed and the board of his Institute wanted to put the method for the State Prize. It had first to be tested in production trials at another institution.

Ramayya and his chief went to an enterprise on the Volga and the trials were successful. The Volga enterprise however held back the trial results. For two members of the Commission were from a rival institution which did not accept Ramayya's theory wanted the trials to be repeated and the other two who accepted the theory conceded to them. The opponents themselves had to concede after the new trials. By then the deadline was past for submitting the papers to the State Prizes Commission.

This was no loss to science. Ramayya worked with persons who put his theory into practice, constructed together with him apparatuses and plants which made his method standard practice, and set up a new technology standard. Among his devices is DK-NAMI for determining the characteristics of oil. His colleagues at NAMI (Institute of Automobile Science in Moscow) nurtured each branch of his science with care.

It is to this science, called chematology in the then Soviet Union and tribochemistry in the West, that we owe fuels and lubricants specially tailored for different kinds of motors and engines in distinct operating conditions. Fuels and lubricants are not just the basic oils distilled from the crude in the refineries. They are blends of basic oils and judicially chosen ad-

ditives designed to meet specific needs, and provide for fuel economy and longer engine life. Kolachala Sita Ramayya was a pioneer when he started blending lubricants for a Chicago firm in the mid-20s and his wartime theories advanced in Moscow led to the creation of a whole new discipline of science.

"Do everything a better way—this is the highest yoga," is what his father, a priest in an Andhra village on what was then the boundary between the Madras province and the Nizam state of Hyderabad, inculcated in Lal Gobind, which was the name Ramayya was given by his parents. The other principle he imbibed from his father was satyagraha and it saved him from the path of terrorism he would have otherwise taken to in anger and protest over injustices he saw around him.

When he finished school and wished to study further, his father said, "Then, you must walk to Madras." The father wanted the son to stand on his own legs, not counting on help from anyone. And yet at every step he received help. Even on the long road to Madras. He met an uncle who was high district official and pressed into his hands a letter of introduction to an Englishman. The letter ensured that there would be no injustice done to the aspirant at the university entrance examinations. He was picked from the physical culture class to run for the university and made an outstanding mark as an athlete. But he had come to the University of Madras to gain knowledge in physics and chemistry. He studied well and wished to acquire much more than what was offered by the university which was significantly better in sports than in chemistry. Going abroad for studies was not all that simple then.

Informed that his father was on the deathbed, Ramayya took the steamer but could see only the funeral pyre. The elder brother did not appreciate his plans for study abroad and, when Lal could not be dissuaded, conveyed the words of their father: "If you have to transgress the sacred laws (by crossing the seas), you should atleast follow three precepts: Don't take alcohol, do not smoke, do not marry a white woman." Not counting a solitary instance, Lal would never be drunk. He could not do without tobacco which became his companion. And, he married two white women.

The Englishman in Madras gave letters to his friends in America. A teacher who turned out to be an activist of the underground communist ring in the port persuaded a ship captain to give him a job aboard so he could earn his passage. The captain wanted the bribe for immigration people at New York to be given to him in dollars. Ramayya entrusted the two thousand rupees his father had bequeathed to a fellow student passenger for conversion. When the captain learnt the chap had vanished with the money, he told Ramayya: "The hell with you. Get into the stokehold." Stoking coal into the furnace tested the limits of his endurance. He not only survived the ordeal but won the other stokers when he alone was not sick during a Mediterranean storm.

The voyage introduced Ramayya not only to the fuel without which the ship would not move but to the lubricant — grease dabbed on the connecting rod of the engine that drives the ship's screw — without it would all the finished within minutes. He did not know then but a thin film of oil would arrrest his attention all life and he would see the whole world in the process that takes place in the narrow gap between the axle and the wheel.

The captain would not give him anything for the services but the stokers forced him to shell out half of the bribe that got Ramayya past Immigration. After a while in New York as dish washer and loader at a hotel, he went to Chicago where he was admitted by the chemistry department of the University. There came a time when he was like a beggar. Everything went for books and debt payoffs, and unable to secure a living he spent the nights hungry like a tramp, on a park bench.

He was broken in. And he accepted the fact he was already an American. His only thought was to survive, to get on, to finish studies. He heard from all sides: "The Rockefeller Foundation. The Carnegie Fund. The Rocke..." But the man who brought him some money was Ponnambalam, a Ceylonese who had received him on arrival in Chicago, befriended and introduced him to the Indian community and to a wider circle of expatriates from everywhere. They went one evening to a party at a communal home. There he met a girl who was captivated by his big, magnetic eyes; and he was struck by her astonishingly beautiful eyes. Cindy offered him a room from which she had moved out without terminating the lease. He accepted it. Better to sleep under a roof rather than upon a bench. They next met at a charity dinner party held by some do-gooders. Later they married, but soon a crack developed in their relationship.

Cindy persuaded Ramayya to attend a charity dinner where would be present a person who could help him if convinced his experiments were worth spending money on. He was then studying thixotropy of a dispersing system to restore the initial technical quality of lubricants destroyed by mechanical action. He had discovered very fast changes in the colloidal medium: from sol to gel and backwards. Money was needed to set up experimental models. Life became easier when he got a foundation fellowship. He finished the Masters at the University of Chicago in June 1924- a year early because he got credit for his University of Madras degree. The day he got his MS he learnt he would get patents for measuring thixotropy and for extending the working life of motor oil. A very famous firm offered him a job with good salary and promotion opportunities. Cindy said: "Now I can speak to my parents about you."

It was like a blow. She realised her blunder and began explaining. If she had kept their marriage a secret it didn't mean she was ashamed of him. He must understand their limitations, their prejudices. He asked her "Will you go with me to India?". She tried to stop that line of conversation and when he repeated the question, she kept quiet. He collected his things and left, answering her why: "Because I love you, Cindy."

Unsung Men Of Science

Ramayya became a commercial traveller in the provinces for a retailing firm. But America speeded ahead, waiving him away as it would a fly. The person he looked for all over America to give him peace and hope was Joe whom he met in New York. It turned out that Joe had in Europe briefly met Anand, the teacher who had introduced Ramayya to the ship captain in Madras.

Joe was working for an American firm in Russia when revolution came in 1917. He stayed on and was, while working in the far east, captured by the American interventionist army, tried back home and let off blacklisted. Ramayya spent three days in Joe's flat reading up Marx and Lenin and learning from his new mentor the arithmetic of American entrepreneurship. He returned to Chicago, made up with Cindy and called at the firm that had offered him a job on his graduation day.

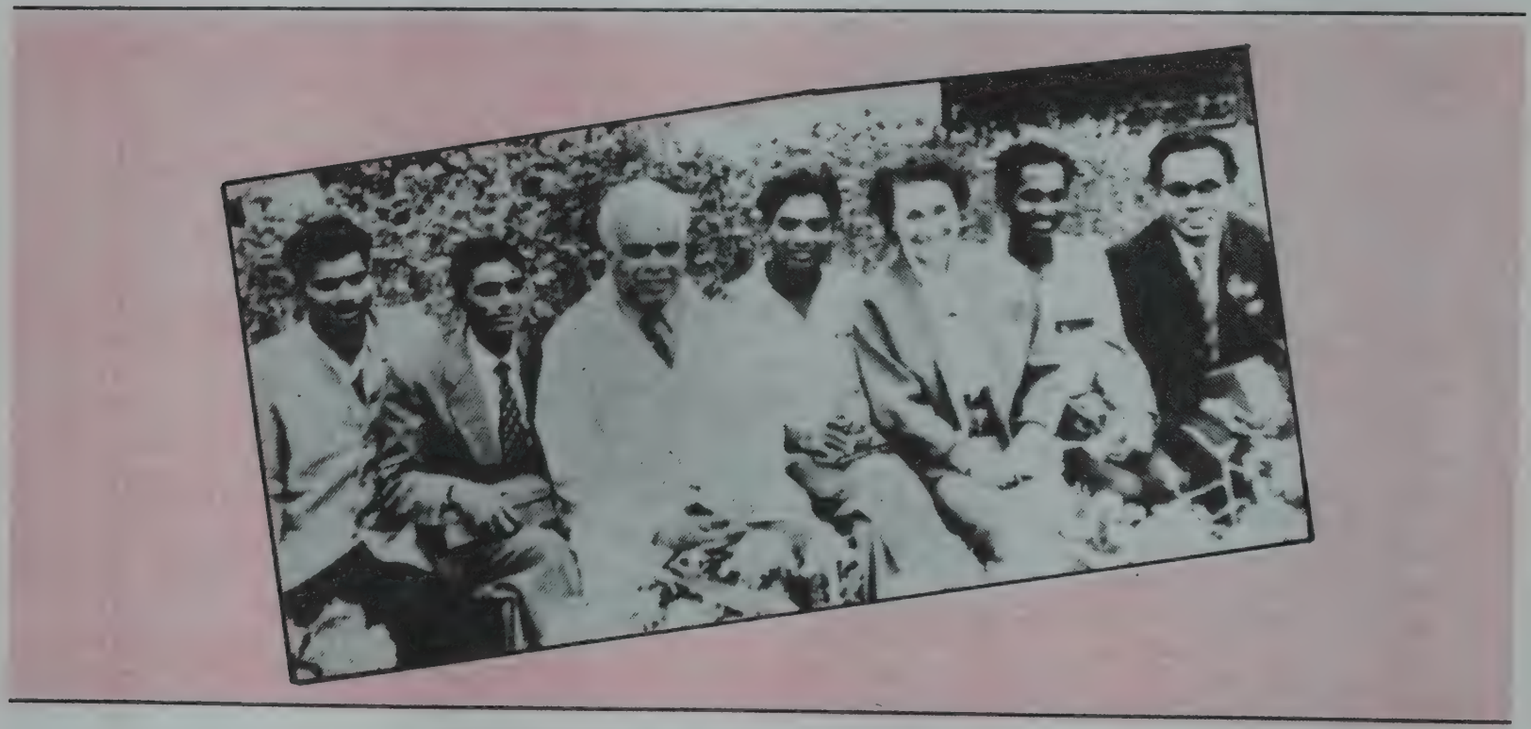
While it built a laboratory for him, the firm sponsored Ramayya's specialist studies at Yale with facilities for practical work at its New Haven pilot plant. He earned his second Masters in a surprisingly short time.

His laboratory was top class — coworkers, apparatus, equipment, everything. He attacked the problem of engine corrosion by motor oil. He straight away saw that the character of friction was qualitatively different during different regimes of the engine. From that understanding came the idea of ingredients (solutions of weak acidity or weak alkalinity) that gave oil a definite buffer quality. They could reduce the friction of engine parts. Wilhelm Van der Henk, the firm's chief executive, talked of a new era of motor building with their "velvety lubricant". Coworkers, the Tindemann Brothers, came up with the apparatus thought up by Ramayya sensitive to smallest changes in lubricant components. They could now imagine clearly what happened in the thin layer of oil at the moment the load changed. The rapid increase in the number of rotations created a crisis: the lubricant was unable to adapt itself to the new regime and so led to corrosion. They thought up a machine that automatically registered the change in the rotations and accordingly poured different lubricants to the moving parts. The machine was even named: "The Velvety Kitten". But Henk douched the idea with cold water, saying it would make the machine costly.

Ramayya's team thereupon came up with the idea of making a lubricant that regulated itself with changing operating conditions. Ramayya was ordered not to speak to anyone about it nor work on it without the management's clearance. The firm was now getting profitable Navy orders. The Tindemanns and coworker Per Malyo were transferred to defence jobs, and the tempo at Ramayya's lab was affected. When he protested, he was told that the management didn't welcome the involvement of Lal (which it knew translated as Red) in "social problems".

Yes, Ramayya had been an activist of a suburban Marxist study circle but had declined to join the Party saying, "I sympathise with Marxism but I am not a communist. I am a humanist."

On the expiry of his contract, the firm offered Ramayya a rise and promotion to section chief. He thanked them but he was leaving for Russia. Cindy refused to be persuaded and, failing to stop Ramayya, threatened to abort their child if he left. When he said she would have nothing to worry financially, she asked: "What will I do with a coloured child?" He answered: "We are going to a country where there are no whites and coloureds."



A visit to Ramayya's was a must for Indians visiting Moscow

She carried out her threat when he went to New York only to discover Joe was dead. Leaving her, the house and the cheque book, he moved into a hotel.

AT Russia, Ramayya was head of a laboratory at the petroleum institute and another at the tractor institute. There were not enough experienced workers and specialists but each did the work of two. There was no technical base but they supplemented the equipment bought abroad with what they could design and improvise from what was available.

He couldn't shake off Cindy from his thoughts. She was uppermost in his mind at moments of failure, at the time they devised an additive for tractor oil, at the May Day parade when he was surprised to find the column of his enterprise carrying his portrait. He missed her. She obtained his address from Ponnambalam so she could take him back to the States but never came to Moscow nor wrote. It would have been fruitless. For he had by then married and raised a family. Ekaterina Ivanovna was an unlettered orphan of German extraction driven by civil war, draught and hunger from village Povolze on the Volga to Moscow where she somehow found strength to work and adjust to city life. a certain similarity of their fates enabled her to understand him when they met. And it just happened they married. But it was Katya who helped Ramayya to get used to his new country, to speak and think in Russian. So different in ethnicity, education and fields of interest, they yet achieved the "soviet of love"; in all their years together they did not fight even once.

When Hitler turned his armies on Societ Union, Ramayya as an Indian felt Russia was the only obstacle between fascists and his defenceless Motherland and asked at Voincomat (recruiting office) to be sent to the front. Just before being marched off, he was ordered out of the column of enlisted home guardsmen and taken to the commandant's office where the director of his institute told him: "Nobody doubts your patriotism but your head is required not as a bullet target but as a weapon." He was ordered to the rear. Within a year he was busy re-establishing the Institute while his family was moved on Siberia. Only work saved him, the work on tank fuel and lubricants.

The tank is not just an armoured tractor. The work regime of its engine is absolutely different. He had to find a fuel that kept the tank manoeuvrable as conditions changed its workload. The image of the tank as an elephant—hardy, fast striving and plastic in movement—gave birth to the idea that a plastic fuel would be appropriate for a plastic machine. Drawing on his American theories, Ramayya carefully tailored kerosene-type fuels for the battle tanks and developed high quality lubricants with special additives. The change of fuel required modernisation of the engine. Soviet tanks with new engines operating on Ramayya's fuels and lubricants—reliable, trouble-free on the battlefield—proved to be superior to German tanks and were in no small measure responsible for victory.

Searching for new fuels and working on additives for tank lubricants, Ramayya was led by his bomb encounters to his concept of *'plasticheskaya prostranstva'* which can be roughly translated as rheological medium—a substance that flows and changes under stress and strain. Out of this concept was born chematology the science that had its Western reincarnation in 1966 as tribochemistry. This is a part of tribology or the science and technology of friction and lubrication of interacting surfaces in relative motion.

The basic concept is set out in the thesis, "The viscous anomaly in oil and its effect on friction in machine", which Ramayya successfully defended to obtain his doctorate in 1951. That it required another 15 years to re-emerge as tribology despite the availability of a Soviet journal in English specialising in chematology is a commentary on the cold war that bedevilled everything including science. Rivalries within the Soviet scientific establishment and suspicions arising out of his Indian origins also may have played their part in Ramayya not securing the kind of recognition from the Soviets he was entitled. He retired as head of NAMI department of fuels and oils.

Without giving up his scientific quest he also made his mark on the literary scene in Moscow. It was in a sense a second working life. He unwittingly got involved in helping Svetlana Dzenith in the compilation of a Telugu-Russian Dictionary and his circle of acquaintances widened to include philologists, linguists and translators. And, students of Telugu when he helped Nikita Gurev with his Telugu course at the University of Leningard. He was happy to be commissioned to translate Etukuri Balaramamurty's *A Brief Survey of the History of Andhra People* into Russian in 1956. A visit to his house became a must in the 1950s for the swelling number of Indians - scientists, scholars, artists, writers, students - who went to Moscow.

Sergei Baruzdin, author of poems on India, called his life "a wonderful odessey of an Indian marxist". He was variously known as "Russian Andhra", "Moscow Andhra" and "Soviet Andhra". The basic thoughts of his last scientific work, "The induction Period of Precipitation—a new index of motor oil quality and effectiveness of additives in them", was published posthumously and deserves to be better known.

Busy with his routine, he left behind only memories and a few scientific articles. His magnum opus, The Theory of the Plastic (Rheological) Medium, remained scattered in lectures. The workers of his publishing house "Progress" saw him off on his last journey. The cortege paused at NAMI for his scientific colleagues to pay homage. Ambassador Inder Gujral spoke at the funeral: "We are bidding goodbye to a great scientist, a great son of India and son of mankind."

Ms. Jain is free-lance writer. Shri Gupta is a free-lance journalist. Address: Ella's Cottage, B-108, Gulmohur Park, New Delhi-110049.

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B.S. MAHAJAN

explains why.

WHEN Ashok was admitted to a hospital for typhoid, he had little idea about the trauma which lay ahead of him. He was put on chloramphenicol, the favourite drug for curing typhoid. His fever subsided within two days, but then on the fourth day, again there was a rise in temperature. Doctors realised that the bacteria, *Salmonella typhi* which cause the disease, have become resistant to chloramphenicol : the bacteria were challenging the drug and not getting killed. Hence they prescribed ampicillin and a broad spectrum antibiotic, cotrimoxazole (septran). The doctors were blindly hitting out at the typhoid bacilli with powerful drugs. When these drugs also failed to cure the disease, they cultured the typhoid bacilli for drug sensitivity in a laboratory and found that *Salmonella* were getting killed by ciproflozacine. Subsequently, Ashok was put on this drug and was cured. After nearly three months of hospital-stay and payment of hefty bills, an extremely weak Ashok was discharged.

While treating different infectious diseases, physicians throughout the world are encountering similar, and often more fatal, instances of microbial drug resistance. In these instances, microorganisms, mostly bacteria and fungi, do not get killed by the drugs — as they have become resistant to the given drug (s) — and the patient continues to suffer. In other words, the bugs seem to stage a comeback. In such a situation, doctors normally change the drug-prescription or give a combination of drugs. In this fight between the drugs and microbes, the latter have been helped by the widespread use — and often misuse — of these chemicals.

The first instance of drug resistance was observed in the early 1940's when some bacteria were found to have developed resistance against the antibiotic penicillin used extensively after the Second World War. As more powerful antibiotics like streptomycin, tetracycline and chloramphenicol were developed and also widely employed for treating diseases, bacteria evolved ingenious ways to meet their onslaught. Today drug resitance is found in virtually all kinds of microorganisms. These include the food-borne pathogens such as *Salmonella, Staphyiococcus aureus* which feast on wounds and causes ear complications and deafness, sexually transmitted organisms and enterococcal bacteria which can cause urinary tract infections and sepsis after a wound injury or a simple surgery.

Immediately racing behind these drug resistant bacteria are viruses that cause AIDS, herpes and influenza, a whole lot of pathogenic fungi and parasites like the plasmodium which cause malaria. According to an infectious disease expert, Harold Neu of the columbia University, USA, "...we have an epidemic of microbial resistance".

The warning signals are all around us, worldwide, and now it is up to the society at large to decide its next course of action: to disregard these signals and thereby increase human suffering (including many deaths) and bear the ever-rising health costs, or chalk out strategies to meet the onslaught of drug-resistant microbes.

There are two aspects of the problem of drug resistance which are of interest to us. On one hand, special chemicals (drugs and antibiotics) are designed to kill or inactivate the disease causing organisms (pathogens). On the other hand, pathogens have evolved highly sophisticated (and structures) to dodge or inactivate these drugs.

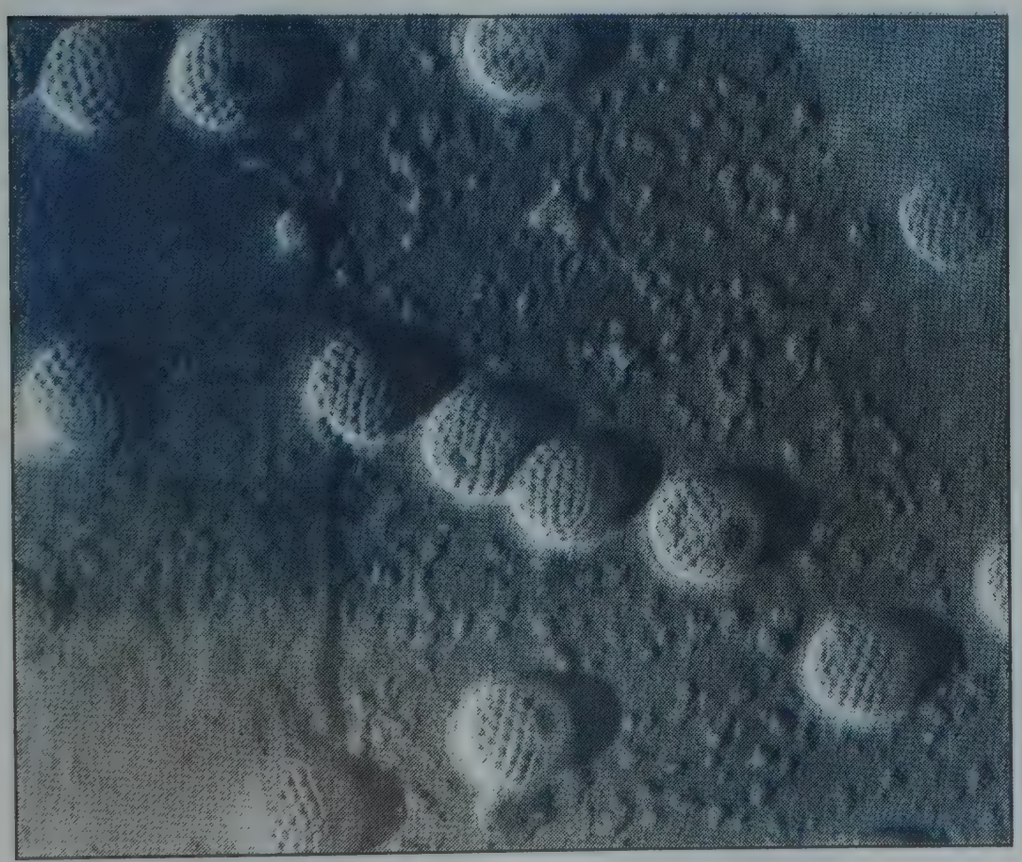
The main principle of action of any antibiotic is selective toxicity. This means that the drug in question has to be harmful to pathogens without affecting the host cells. Generally, an antibiotic inhibits the growth of microorganisms by binding to specific target sites in their cells and then interfering with synthesis, assembly or function of the macromolecules of these microbial cells. Antibiotics effectively inhibit bacterial cell wall synthesis, protein synthesis and DNA replication. For instance, penicillins bind to certain proteins of the microbes required for cell wall synthesis and prevent its synthesis. Since the internal volume of these cells is constantly increasing, the cells soon burst open (lyse) and die. Other antibiotics such as streptomycin, kanamycin, gentamycin, spectinomycin and berythromycin rapidly zero in on to bacterial ribosomes (involved in protein synthesis), leading to synthesis of defective proteins and then to eventual death of the bacterium. Chloramphenicol blocks the protein synthesis itself.

These antibiotics are effective as long as there is normal biosynthesis of the target structures in microorganisms; they are rendered ineffective if there is any change in the structures to which the antibiotics bind. If this

happens, one can say that the microbe has now become resistant to the exposed drug. It can happen through mutations in the pathogen. Luckily, such mutations are extremely rare. But when they arise, they rapidly spread in the fast multiplying pathogens and raise an entire population of resistant cells. In practice, the patient under antibiotic treatment would initially respond to an antibiotic but then have a relapse and again fall sick. Under such circumstances, using two or three antibiotics could be helpful, at least such was the thinking in the early 1950's.

THIS beautiful dream was shattered in 1955 when the first evidence of multiple drug resistance (MDR) was reported from Japan. It was observed that the bacillus of the genus Shigella, causing dysentery, was simultaneously resistant to several antibiotics. More worryingly, MDR was found to be easily transferred to other organisms, of the same or a different genus (in this instance to the common gut bacteria, *E. coli*). Probing of the MDR phenomenon revealed that the resistant strains were somehow modifying the antibiotics with the help of enzymes. Hence these modified antibiotics became blind to their cellular targets and lost their sting. Further research revealed that these enzymes were coded by genes located on small fragments of circular DNA, now popularly called as plasmids. Besides carrying the genes for drug-resistance, plasmids also carry genetic information for their own replication and easy transferability enabling them to move from one organism to another. These findings make it easy for us to understand the rapid spread of MDR among other organisms. Besides plasmid-borne resistance genes, drug-resistance can also arise by cell-to-cell gene transfer.

Rapid advances in different areas of cellular and molecular biology and genetics, especially in the last three decades, have enabled scientists to unravel diverse sophisticated ways evolved by microbes to fight the many agents meant to kill them. Drug resistant bacteria have genes that either inactivate a particular antibiotic or pump them out of bacterial cells. Antimicrobial agents are rendered inactive by three major mechanisms (so far discovered): by destruction or modification, of antibiotic prevention of access to the target and by alteration of the antibiotic target site.



Electron micrograph of Salmonella which causes gastrointestinal disorders

A surface membrane molecule (a unique glycoprotein called as P-glycoprotein) has recently become the focus of intense research. This complex molecule, made up of proteins and carbohydrates and usually associated with the plasma membrane, seems to be highly conserved or almost same in composition in a variety of organisms. Work on cancerous tissues, notorious for MDR, reveals that increasingly large amounts of P-glycoprotein molecules (due to gene amplification) are produced as drug resistance builds up in a tissue or cell. Resembling a membrane transport protein, it seems to pump out drugs in more than one way. Though further work needs to be done in this direction, scientists are quite optimistic about designing drugs which can somehow inhibit the functioning of P-glycoprotein or bypass it.

MDR was seriously taken note of in India only in late 1972, with an outbreak of a typhoid epidemic in Kerala. Massive antibotic pollution in the environment followed by large-scale oral antibiotic administration in the local population seemed to have triggered this situation. Over the years, studies conducted at the different ICMR centres in the country and at other institutions, indicate that MDR coliform — (including *Klebsiella)*, dysentery, and typoid-bacilli, and several salmonellae types causing gastroenteritis, food poisoning and typhoid, are widely prevalent among Indians all over the country.

More recently, several outbreaks of infectious diseases (like the Dombivali fever in Bombay and a diarrhoea-epidemic in Indore), which claimed many lives have also been

Drug Resistant TB Bacteria?

HEALTH authorities in several countries of the world, especially in the West, are highly unnerved at the widespread emergence of MDR in *Mycobacterium tuberculosis*, the bacteria causing tuberculosis. Resistance in TB bacteria represents an alarming situation as unlike many other serious infections, difficulty in breathing is a prominent and an early manifestation of the disease. Inability to relieve this symptom with any of the known drugs (due to drug resistance) can often prove fatal. It is estimated that those TB patients resistant to two or more major antibiotics, have a fatality rate of around 50%. Luckily, MDR for TB has not yet been officially reported in India. If MDR strains of TB bacilli do crop up in the country, the effects can be quite disastrous in terms of human suffering and the high costs of treatment.

How did the TB bacteria acquire resistance to drugs ? We do not have a complete answer to this question yet, but findings published in *Nature* (13 August 1992, p. 538) highlight the genetic basis for resistance to TB drugs. This is an important finding and gives us an insight into the complex mechanisms of resistance to the drug isoniazid (isonicotinic acid hydrazide, INH), one of the most potent anti-TB drugs and also most frequently used for TB treatment. INH has the peculiar property of inhibiting the growth of mycobacteria and not the other pathogens. Ying Zhang of the Medical Research Council's TB unit at the Hammersmith Hospital, London, and Stewart Cole at the Pasteur Institute in Paris and their colleagues have shown that, interestingly, in this instance the resitance is due to loss of a gene. (You will recall that drug resistance so far discovered has been ascribed to the presence of a gene). This gene produces an enzyme (catalase), which in its turn, converts INH to a toxic compound.

To start with, the researchers worked with a related bacterium, *Mycobacterium smegmatis*. The team took a mutant strain of Mycobacterium that was resistant to INH. Bit by bit, they inserted stretches of DNA from a normal drug sensitive strain of *M. tuberculosis* into a series of copies of the resitant strain. Each copy was tested for its response to the drug. This way one copy was found to be highly sensitive. Further analysis revealed that the gene that was inserted in this copy was responsible for production of an enzyme, catalase. "When we put the catalase gene back in, we restored the drug sensitivity", says Zhang. Catalase, which the bacterium uses normally, appears to convert the drug into an active form that is lethal for the bacteria. Strains that lack catalase are unaffected by the drug. This work does not explain how the TB bacteria resist any of the other drugs, but Zhang believes that these results can positively be exploited to design better drugs based on the active form of INH. The designed drugs should take care of those strains of mycobacteria that lack catalase.

Indian scientists have also contributed their bit in this effort. Their work, though unacknowledged in the popular press in the country, has found mention in the *Time* magazine (August 24, 1992, p. 13) and the *New York Times*. As early as 1975, Gayatri Devi and colleagues in T. Ramakrishnan's laboratory at the Indian Institute of Science, Bangalore, reported (*Biochem. journal*, 1975, 149, p. 187) that the enzyme peroxidase has a specific role in modulating the action of INH in *T. mycobacterium*. These researchers isolated a purified protein with three activities —peroxidase, catalase and Y-enzyme— from the bacteria. These three activities disappeared in strains which were resistant to INH. These observations led them to postulate that a single mutation in *M. tuberculosis*, from INH sensitivity to INH resistance, leads to the loss of catalase, peroxidase and Y-enzyme activities. This biochemical approach was further supported in 1981 by genetic evidence provided by K.P. Gopinathan and colleagues (*Current Science*, 50, p. 216 and *Nature*, 228, p. 280). Using transducing mycobacteriophages (virus particles which live in bacteria and act as vehicles, carrying and expressing bacterial genes from one bacteria to other), they showed that development of INH resistance led to a simultaneous loss of catalase, peroxidase and Y-enzyme activities. In contrast, the transduction of drug sensitivity to a resistant cell resulted in a gain of all the three activities. In 1983, T. Ramakrishnan suggested that in INH sensitive strains, the drug is converted by this protein to a toxic compound, which slows down the growth of *M. tuberculosis*. He gave a tentative structure of this compound.

The above series of experiments carried out at the ndian Institute of Science, Bangalore have been acknowledged by Zang and his colleagues who have now cloned the gene encoding the catalase-peroxidas-Y-enzyme activities. Since Zang's publication, a second gene, also involved in resistance to tuberculosis drugs, has been identified, mapped and its functions are being probed now. The problem of resistance is not that simple to solve. There are patients who have resistance to eight drugs.

B. S. M.

Top Ten Drug Resistant Microbes

Microbes	Disease Caused	Drugs Resisted
Enterobacteriaceae	Bacteraemia, pneumonia, urinary and surgical wound infections	Aminoglycosides, beta lactam antibiotics, chloramphenicol, trimethoprim
Enterococcus	Bacteraemia, urinary tract and surgical would infections	Aminoglycosides, beta lactains, erythromycin, vancomycin
Haemophilus influenzae	Epiglotitis, meningitis, otitis pneumonia, sinusitis	Beta lactams, chloramphenicol, tetracycline, trimethoprim
Mycobacterium	Tuberculosis	Aminoglycosides,ethambutol isoniazid, pyrazinamide, rifampin
Neisseria gonorrhoeae	Gonorrhea	Beta lactams, spectinomycin, tetracycline
Plasmodium faciparum	Malaria	Chloroquine
Pseudomonas aeruginosa	Bacteraemia,pneumonia, urinary tract infections	Aminoglycosides, beta lactams, choram phenicol,ciprofloxacin, tetracycline, sulfonamides
Shigella dysenteriae	Severe diarrhoea	Ampicillin,trimethoprim sulfamethoxa-zole, chloramphenicol, tetracycline
Staphyloccoccus aureus	Bacteraemia, pneumonia, surgical wound infections	Chloramphenicol,ciprofloxacin,clindamycin beta lactams, rifampin, tetracycline, cycline, trimethoprim
Streptococcus pneumoniae	Meningitis, pneumonia	Aminoglycosides, chloramphenicol, erythromycin, penicillin

Source : George Jacoby : *Science*, 21 August, 1992

traced to MDR bacteria.

Experts in infectious diseases advocate bold new strategies — at the scientific and at the community levels — to combat the problem of drug resistance. For one, considerable basic research, aimed at finding newer "rational" drugs to which resistance cannot easily develop, has to be done. The medical community will have to exercise considerable restraint while prescribing antimicrobials, especially broad spectrum antibiotics. Education of doctors, especially in India, in areas of basic biology and genetics, has to be strengthened to a great extent. At the community level, sanitation and public hygiene also needs to be monitored and further fortified to bring down the overall incidence of infectious diseases (note that antibiotics are used solely for treating infectious diseases). Of relevance here is a recent report in the *New England Journal of Medicine* (9 July, 1992). It states that in a community under study, infectious diseases recorded a remarkable decline when doctors washed their hands (before seeing any new patient) with soap and an antiseptic. In contrast, incidence of these diseases was high when doctors used only soap, or soap and alcohol. Patients also have to do their bit by taking antibiotics only when given by a doctor, finishing the treatment and not demanding antibiotics, especially for viral infections. Similar approach is to be followed by vets while giving antibiotics to livestock.

On the positive side, a global computerised network — WHONET — for detection and early surveillance of resistant strains, is already operating. Several major pharmaceutical companies are again initiating major research programmes in basic genetics and microbiology which eventually should help in designing more rational antimicrobial drugs. But in order to really keep ahead of these genetically versatile microbes, a more com prehensive approach combining all the above elements, is needed.

Dr. Mahajan is a scientist with the Homi Bhabha Centre for Science Education, TIFR, Bombay

For Her

OUST THE ODOUR

V. VEMURI

ODOUR plays a complex role in our lives. Odour is the sensation of smell when the olfactory cleft high in the nasal passages containing over 10 million receptors is stimulated by gases and vapors. Smell is important in the enjoyment of food, the attraction of one person to another, and in evaluating the cleanliness of our surroundings.

Odour perception is subjective; what appeals to one may nauseate another. What may be a pleasant odour in one context may not be so in another. The aroma wafting from a fresh loaf of bread or a fresh pot of coffee carries a heavenly message to the person getting up from bed, while the lingering odours from cooking or smoking are certainly not welcomed by everyone. Although one odour may seem more pleasant than another, virtually all odours become unpleasant when perceived in high concentrations. While words like aroma and flavour leave a positive impression, the word malodour means an undesirable scent. Malodours can signal poor, and unsafe conditions.

Baking soda and charcoal are two common substances to help in our battle to control undesirable household odours. An open box of baking soda in the refrigerator can control food odours. Did you know that pieces of charcoal in shallow open containers will absorb more odour better than baking soda ? Charcoal can be used to control odours in other parts of the house too. If you are a smoker, try charcoal to remove tobacco odour, make sure the open charcoal containers are placed out of reach of children and pets. Replace the charcoal periodically for best results.

Every adult, from head to foot, has a unique scent; it is almost like a fingerprint. It is by this scent a bloodhound recognizes the criminal it is tracking. Infants recognize their mother by this smell. No amount of washing or perfumes can disguise this smell.

When one talks about body odour, one means "bad" smell coming from the mouth, underarms, genital area, and feet. Bad breath, or halitosis, is usually the result of salivary juices acting on leftover food trapped in the mouth. Washing the mouth after eating, regular brushing, and flossing are normally sufficient to control this kind of odour. Certain foods such as onion and garlic, as well as tobacco and alcohol, produce odours that linger inside the mouth despite brushing. But chronically bad mouth odours may be due to dental and gum diseases or due to an infection of the sinus cavity.

Onions and garlic, the "lilies of kitchen", do not smell like lilies. In fact, garlic has long been better known as the stinking rose. Garlic has the added reputation of warding off viruses, bacteria, vampires as well as neighbors. It is especially notorious for causing malodours because garlic enters the body through the mouth and its odour exits through the skin. This is why it is so difficult to tolerate, even the proximity, of heavy garlic eaters. If you think that my opinion is biased, let us see what others think. "Eat no onions nor garlic, for we are to utter sweet breath" is Shakespeare's prescription to bad breath. "Lest your kissing should be spoiled, Your onions must be thoroughly boiled" is the more humane prescription from Jonathan Swift.

In spite of this bad billing, garlic is considered good for your health. After all, there is some wisdom in the age-old Telugu proverb, *"ulli chesina melu talli kooda cheyyadu"*, which means that "even a mother cannot help the way a garlic can". Is there any truth in the belief that garlic can ward off viruses and bacteria ? Dr. Benjamin Lau, M.D., Ph.D. of the Loma Linda University School of Medicine, an institution run by Seventh Day Adventists, a religious group who neither smoke nor drink and many of whom are vegetarian, believes that garlic is effective against viruses, bacteria, spirochetes, molds, yeasts, and parasites. There is also a general belief that garlic is useful in lowering the blood cholesterol level and in controlling hypertension.

Does this mean that we have to smell bad to feel good ? Dr. Isao Sakai, of Japan, who holds dozens of patents on odour control, took more than a decade to develop "sociable garlic". His patented discovery consists of a special solution containing "natural silica and organic plant sources" that neutralizes the substance in garlic that reacts with body chemicals to produce odour on the breath. In this process nothing is added to the bulbs, only the odour causing ingredients are removed. This appears to solve the problem of those who love them too. Indeed, Kyolic garlic, in capsule form, has no odour at all. If you are only interested in the health benefits of garlic, then this is the way to go. Another effective way of combating mouth odours resulting from foods is to chew green leafy stuff high in chlorophyl — a natural breath

freshener. This is the reason behind the Indian custom of chewing paan.

Body odour below the neck line is primarily due to perspiration. Sweat, which is produced by the apocrine glands, has no odour, it is 99% water with traces of salt. When exposed to air, it quickly evaporates. When clothing or high humidity reduces evaporation, waste products of bacteria on the skin mix with sweat, producing bad smell.

Combating malodour is a major challenge faced by the manufacturers of cosmetics and perfumes. One challenge is that scent glands differ from race to race and from males to females. George Pretti of the Monell Chemical Senses Center in Philadelphia analyzed the bacterial wastes and isolated more than three dozen chemical compounds that can be odiferous. The biggest culprit among these is the compound with a mouthful of name—3 methyl-2-hexenoic acid. Of the two types of skin bacteria that feast on the secretions from the apocrine glands, the one that produces the strongest and most pungent odour is affectionately called, lipohilic diphtheroids. Why do scientists choose to work on the excretions of such bizarre creatures ? You see, manufacturers are desperate for the molecular model of the chemical that produces the offending odour. Using these models they can test new formulas for deodorant ingredients that more effectively block bad odours.

How do you combat the lingering foot odour that is left in the shoes long after the dirty socks are removed ? An old fashioned way is to stuff the offending shoes with small cotton bags filled with bits of charcoal. A fancier and more expensive method is to buy Odour Zappers, bags filled with a mineral of the zeolite family, being marketed in the U.S. The chemical absorbs both the moisture and the odour. The bags can be regenerated by hanging them in the sun for a couple of days.

Regular bathing with soap and water and regular changing of clothes and socks is the best method of controlling body odour. Avoid wearing tight fitting clothes made with synthetic fabrics that cannot "breathe." Deodorants, like aluminium chlorohydrates, isopropyl palmitates, and cyclomethicones that make up most of the cosmetic roll-ons and sprays, can help by slowing bacterial growth. Anti-perspirants can also help by blocking sweat ducts. Recently, a new product, called *Le Crystal Natureal*, made in France, entered the U.S. market. It is a natural mineral rock processed into consumer sized bars. Simply moistening and rubbing the rock against the skin helps kill odour causing bacteria. A 6-ounce stone costs $ 15 and lasts about an year. If this sounds like a bit too much to your budget, gently rubbing the body with a handful of clean soft coconut fiber will just do the trick. Perhaps there is some wisdom in the age old Indian custom of taking a weekly "oil" or *abhyangana* bath. The process of applying oil and subsequently removing it with a paste made out of coarse rice flour is India's *Le Powder Natureal* sans Madison Avenue.

Heavy reliance on chemicals is not advisable; perfumes, in moderation, in conjunction with good daily hygiene is a good solution to the body odour problem. It is neither possible nor desirable to try to completely eliminate body odours. You don't want to kill helpful bacteria on the skin while trying to kill the harmful ones. Some olfactory researchers at England's Warwick University recently found that a compound in sweat, Osmone 1, actually works as a substitute for a tranquilizer. Finally, what if future researchers tell us that odour producing chemicals on the human body also contain pheromones, the chemicals that attract the opposite sex ! Clearly, there is more to this than meets the nose.

Dr. Vemuri is a professor at Department of Applied Sciences, University of California, P.O. Box 808, L-794, Livermore CA 94550

PRIZE WINNER

Why is it impossible to melt wood?

Rajendra Sharma
Bombay (Maharashtra)

Every substance has a specific molecular structure in which the molecules or atoms are held together by weak forces. For melting a substance, it has to be heated upto its melting point. Heating any substance means raising its temperature thereby breaking up the weak forces holding the molecules together. These molecules become energetic enough on heating and destroy the fixed structure of the material. For example, the plastic on heating starts melting because of the breaking up of weak forces between the molecules of which it is composed of. But wood or any other combustible material combines with oxygen and starts burning before the melting point stage is reached. Therefore, it is impossible to melt wood.

Madhu Sahni

Why does warm water freeze faster than cold water?

Prabhat Kiran
Shekhpura (Bihar)

The Newton's law of cooling states that the rate at which a body cools is proportional to the difference in temperature between the body and its surroundings. Being at a higher temperature, warm water cools at a faster rate than cold water. It therefore reaches the freezing point faster than the cold water and is subsequently first to freeze. It is also possible that the warm water, being at a higher temperature, loses mass through evaporation at a faster rate than cold water. By the time the warm water cools down to the freezing point, its mass has become less than that of the cold water. So, to freeze this warm water less amount of heat has to be removed from it than from the cold water. The warm water therefore freezes faster than the cold water. eration theatre too, it would undoubtedly get stained with blood in no time.

Dilip M. Salwi

Why do eagles fly at heights without flapping their wings?

Subhash Chandra Ojha
Paharpur (Bihar)

Small birds have to flap their wings very fast to climb up in the air as well as to remain air-borne because the area of their wings is small. Big birds like eagles do not have to flap their wings very fast to climb up or stay air-borne because the area of their wings is quite large. However, to climb up to great heights, big birds do not simply use their wings but also thermals, rising columns of hot air. They flap their wings to climb up in the air and ride a thermal. It is while they are soaring on a thermal that they do not have to flap their wings as the air currents carry them to great heights. To continue soaring, they have to move on to another thermal by flapping their wings, and then on to another, and so on.

Dilip M. Salwi

Why do we use sand to fry groundnuts in a pan instead of heating them directly in the pan?

P. C. V. Harinee
Hyderabad (A. P.)

The process of dry frying or roasting, frying in oil or boiling are more or less the same. The basic principle is to cook the food-stuff by giving almost uniform heat for a long time from all sides of the material being cooked. Same is true for groundnuts also when we roast them in sand in a pan. Since sand is a good absorber of heat it can be heated to quite high temperature very quickly and it maintains this temperature for a long time. When we put groundnuts in heated sand, they get roasted uniformly from all the surfaces and also from inside without getting their outer surfaces burnt. If we try to roast them by putting them directly in a pan, the outer surface which is in direct contact with the pan will get burnt in no time and the inner core will remain unroasted. Same could be done by roasting groundnuts in heated air, but the heat-holding capacity of air is very low. Hence we use heated sand instead of air.

Neeru Vig

Why can't we run backwards as fast as we can run forwards?

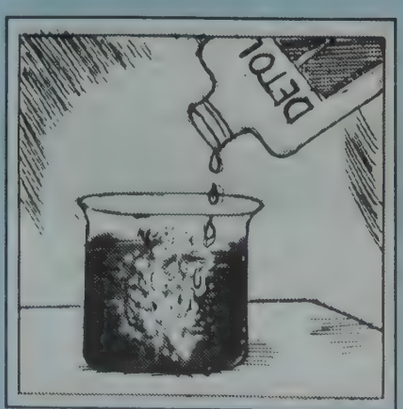
Siji Cyriac
Bombay (Maharashtra)

While running or simply walking, bending and other flexible movements of different parts of our body play very important role. First of all, the spine allows our body to bend in the forward direction only. Bending in the forward direction while running helps in maintaining the balance. Secondly we have knee caps only in the front due to which our legs can fold and unfold only in the forward direction. Thirdly, the construction of our feet. These have flexible toes in the front and rigid heel in the back. These flexible toes push the ground back and make it push us in a forward direction. This is not possible while running backwards. Moreover, we have eyes only in the front and so turning our head backwards to see behind is very inconvenient if we have to run backwards. All these factors add up to the speed with which we can run. Therefore, it is very difficult to run backwards with the same speed as we do in the forward direction.

Neeru Vig

Why do phenyls and dettol turn water milky white when mixed with it?

C. Ravishankara
Boirdavar (M. P.)



Any substance which is soluble in water will completely dissolve in it and form a clear and transparent solution. But oil based substances are immiscible with water and so they form a fine emulsion. Since dettol and phenyls contain substances that are immiscible with water, they do not mix when added to the water. However, they also contain some chemicals which act as surfactants or detergents that help in breaking up of the oily layer into small droplets. This makes dettol or phenyl to form a fine emulsion when added to water and make it appear cloudy. Since the emulsion is formed of fine droplets of the immiscible liquid and the amount of dettol or phenyl added is also quite small, the emulsion stays and does not separate out into a different oily layer on standing.

Madhu Sahni

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D-for Fast Healing

WOUND healing, though leaves a ugly scar, is a very important biological phenomenon. It guards you against bleeding to death from cuts and infections by deadly bacteria. Besides, it repairs the torn skin. A good lot of factors — nutritive as well as chemical — have been prescribed as aiding this phenomenon. For example, it is very well established that Vitamins E and A are inevitable for a proper healing of wounds. Can't blame the surgeons for prescribing Vitamin tablets by score, isn't it ? But, are other vitamins as necessary too ? K.V. Ramesh and colleagues of Kasturba Medical College, Mangalore, Karnataka, believe that vitamin D too may be aiding faster wound healing. In a research article in the *Indian Journal of Experimental Biology* (September 1993) they report that vitamin D fed to wounded rats did improve the healing. Not surprising, because it is very well known that vitamin D has a hand in the proliferation of blood cells, immune cells which protect body from infection and skin cells. It also influences the growth of smooth muscle fibres. In their report, Ramesh and colleages show that probably due to these effects of vitamin D, the wounds in rats fed with vitamin D grow the top layer of skin (re-epithelization) faster and that the healed wounds were much stronger. One more addition to vitamin tablets, isn't it ?

Hacker's Trouble

WHY even very experienced keyboard operators commit so many errors ? Allan Kennedy and Wayne S. Murray, two psychiatrists at the University of Dundee, U.K., say that is because the operators' eyes looking at the flickering light on the computer screen get tired. This, Kennedy and Murray found out, happens even if the computer has been refreshed or tuned to project clear images on the screen. Reporting the findings of a study in which 24 volunteers tried reading out characters appearing on a screen in *Nature* (Vol. 365, No. 6443, pp. 213, 1993), they say that even those screens where images appear stable disturb the eye movements. Soon tired eyes start seeing wrong. Thus continuous working at a computer station means an increased demand on concentration and increased visual fatigue. They say that all the measures presently available to rid the computer user of this malaise are only deceptive and that the eyes continue to be tired inspite of these fine adjustments.

New Spray Can

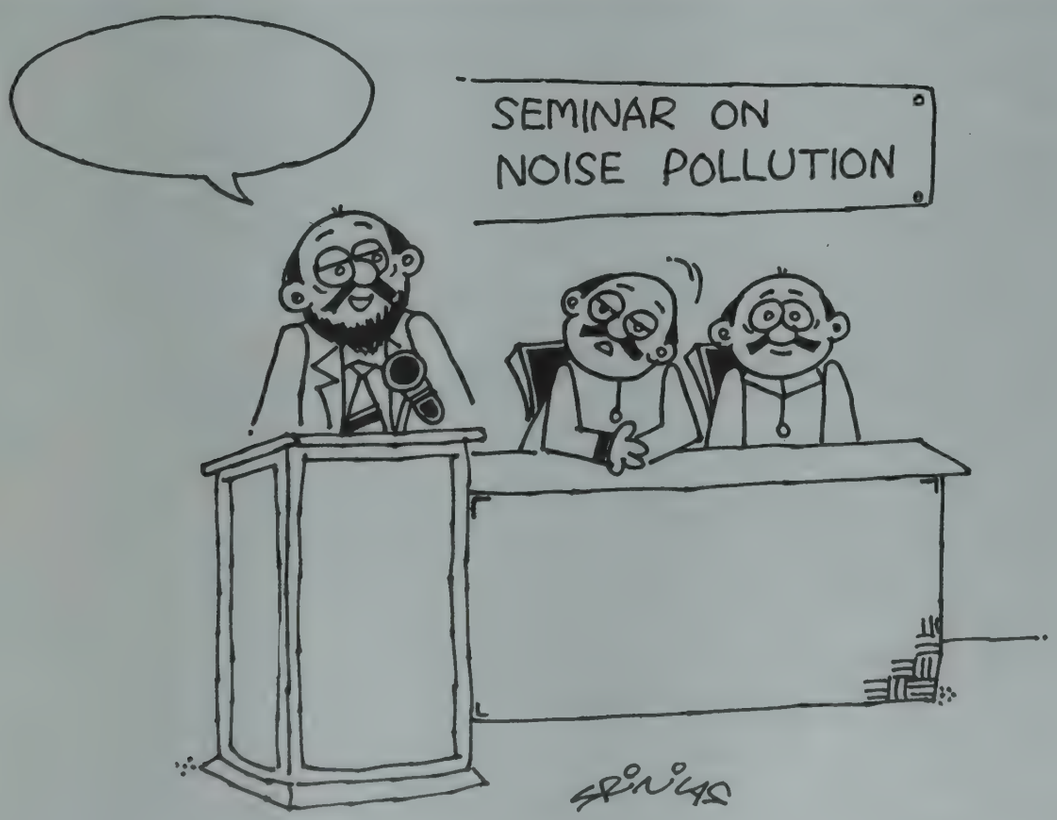
SPRAY cans — those fashionable press-a-button and get whatever-toiletry-you-want cans—have earned the ire of most of the green-minded. One of the reasons for their anger is that the can sprays out the ozone-destroying chlorofluorocarbons (CFCS) along with its other contents. They are also sore that these cans can not be recycled. For, there remains a little bit of the CFCs as well as the main content in the can even after it is disposed of. Now a U.K. based company Boxal has come up with a roll-bag spray can that would please the green-revolutionaries. The can has the dispensable content packed inside a thin aluminium bag which rolls up—as the contents are dispensed of. Besides it also prevents the dispensed contents from coming into contact with the propellants — the CFCs. It means no CFC is released into the atmosphere. Also it does away with the tubes usually seen in other spray cans. As contents of the aluminium bag are squeezed out completely by the expanding gas surrounding the bag, there will not be much remainder in the empty can. Also, the aluminium roll-up bags can be removed and the disposed can reused. Thus, the manufacturers hope that the new roll-bag can will reduce much of the garbage problem too.

Facts are Sacred

FACTS are sacred and to err is human are the two truths in which all scientists have faith. Infact, the very foundation of science stands on these two premises. As an example of this, R.H. Wentorff Jr and his colleagues at the General Electric Company, U.S.A., have publicised the fact that they had committed a blunder, albeit unknowingly, thirty eight years ago which brought them name and fame. Wentorff and his team are famous as the first to artificially make a diamond. A single crystal of a rare kind of diamond found in the reaction mix of an experiment they had conducted in 1955 brought them the fame. In a letter to the British journal *Nature* (Vol. 364 (6439),1993) they admit that they mistook a natural diamond which had got mixed, unknowingly, in the reaction mix as artificially produced.. The realisation took so long to come only because the steel vessel in which Wentorff team had pressurised hot graphite to form diamonds was only recently found incapable of withstanding the high-pressures required to produce diamonds. The steel vessel when reexamined could stand only 42 kilobar of pressure whereas it requires at least 53 kilobar pressure to make diamonds under the conditions used by Wentorff team. Well, it is never too late to be honest, isn't it?

Better Battery Soon

ANOTHER hope for those who are anxious to have a high-power, solid battery to run pollution-free electric vehicles comes in the form of a research paper in *Science* (Vol. 261, pp. 1029, 1993). In a basic research advance, American scientists have developed an aluminium and sulphur based powerful battery. The scientists Dharmasena Peramunage, a Sri Lanka-born American and Stuart Licht of Clarke University, Massachusetts, U.S.A., have found interfacing sulphur with an acqueous polysulphide solution turns the solution into a conductor. The battery containing solid sulphur cathode (negative terminal) polysulphide solution and aluminium anode (positive terminal) generates about 1.3 volts of electricity. But the energy-density is quite high and it continues to generate electricity for a longer time. It has an energy-density of up to 220 watt per hour which is several times higher than the common lead-acid car battery.



Cartoon by ***B. Srinivas, ISJP Division, Banjara Hills, Hyderabad***

SKY CORNER

DECEMBER

MAGNITUDES

- Minus One
- Zero
- First
- Second
- Third
- Fourth

South ♄ Saturn

December

THE diagram shows the evening sky as seen from latitudes 0 to 40 degrees North. The inner circle represents the horizon as seen from latitude 22.5 degrees N. The chart has been extended on the northern and southern sides for use all over India. Beginners wanting to use the chart should hold it overhead and turn it in such a way that the North, South, East and West marked on the chart point to the correct directions. With some experience it would be possible to use it in a more convenient position. With the help of a few known star groups in the sky the remaining stars can be easily identified using the above chart. From a particular place these stars will be seen at about 2130 hrs. 2030 hrs., and 1930 hrs. of local mean time on 1st, 16th, and 30th of the month.

The star chart meant for a particular day for a given hour can be used for the next day 4 minutes earlier and for the previous day 4 minutes later. For example, if a chart is meant for 8.30 p.m. for 16th it can be used on 17th at 8.26 p.m. and on 15th at 8.34 p.m. In the same way it can be used for other months; for 16th November it will hold good at 10.30 p.m. and for 16th January at 6.30 p.m. and so on.

The stars move from east to west in the sky in their daily motion (due to rotation of the earth) at a rate of 15 degrees per hour. The chart can also be used at other hours in the evenings after taking into account the above shift in position of the stars.

Planetary Positions for December, 1993

Date	*1st*		*10th*		*20th*	
Planets	*R. A.*	*Decln.*	*R. A.*	*Decln.*	*R. A.*	*Decln.*
Mercury	15h 17m	16.4S	16h 10m	20.4S	17h 15m	23.6S
Venus	15h 42m	18.8S	16h 29m	21.3S	17h 23m	23.0S
Mars	16h 58m	23.3S	17h 27m	23.9S	18h 00m	24.2S
Jupiter	14h 09m	11.9S	14h 16m	12.5S	14h 23m	13.1S
Saturn	21h 50m	14.7S	21h 52m	14.5S	21h 55m	14.2S

Adopted from figures supplied by Positional Astronomy Centre, Calcutta.

The Moon

THE new moon occurs on 13th at 02.57 p.m. and the full moon occurs on 29th at 04.35 a.m. I.S.T. The moon passes about three and a half degrees south of Jupiter on 10th, very close to Mercury and Venus on 12th and about seven degrees north of Saturn on 18th. The moon is at perigee or nearest to the earth on 10th and is at apogee or farthest from it on 22nd.

The lunar crescent beomces first visible after the new moon day in the evening of 14th.

The Earth is in winter solstice on 22nd.

Planets

Mercury (*Budha*), visible in the morning sky, rises about an hour before sunrise during the first half of the month. Thereafter it comes too close to the Sun to be visible. It passes about 5 degrees north of the star Antares (*Jyestha*) on the 13th. It moves from Libra (*Tula*) to Sagittarius (*Dhanus*) through Scorpius (*Vrischika*). Its visual magnitude is about -0.6.

Venus (*Sukra*), visible in the morning sky, rises about half an hour before sunrise during the first half of the month. Thereafter it comes too close to the sun to be visible. It moves from Scorpius (*Vrischika*) to Sagittarius (*Dhanus*). Its visual magnitude is about -3.9.

Mars (*Mangala*), remains too close to the sun to be visible during the month being in conjunction with the sun on 27th. It moves from Scorpius (*Vrischika*) to Sagittarius (*Dhanus*).

Jupiter (*Brishaspati*), visible in the morning sky, rises about three hours after local midnight during the first half of the month and bout two hours after it during the second half. It is in Libra (*Tula*). Its visual magnitude is about -1.8.

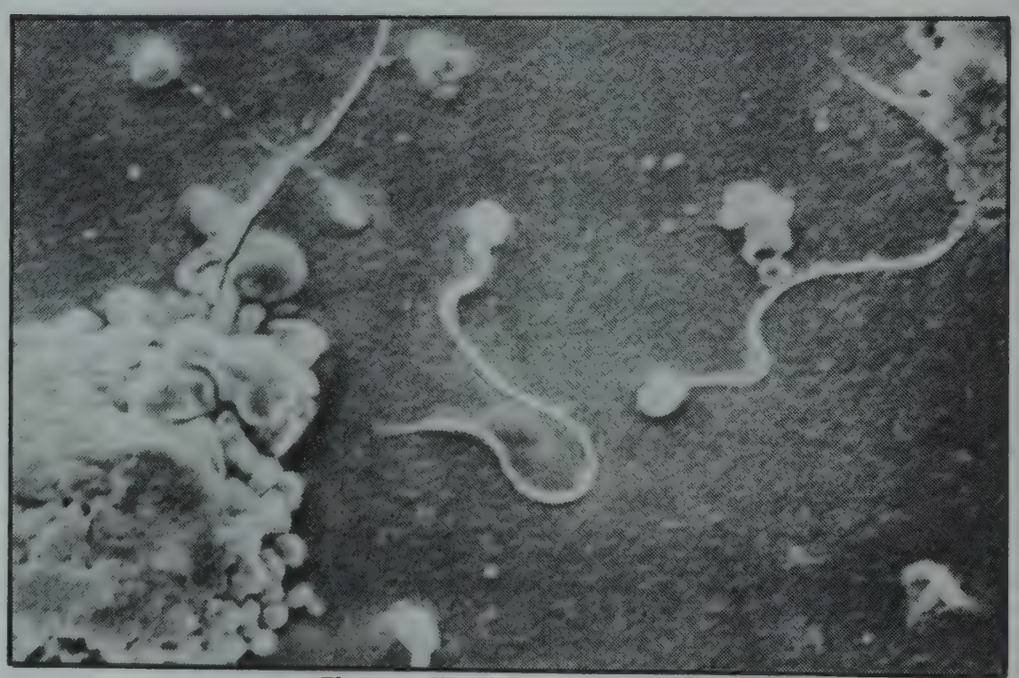
Saturn (*Sani*), visible in the evening sky, sets about two hours before local midnight during the first half of the month and about three hours before it during the second half. It is in Aquarius (*Kumbha*). Its visual magnitude is about + 0.8.

(Source : Positional Astronomy Centre, Indian Meteorological Department, New Alipore, Calcutta-700053

Biotech For Blue Revolution

A. BIJUKUMAR

FISH production from natural water bodies is fast reaching its limits due to indiscriminate, unscientific over-exploitation of natural fish resources. At the same time, human population is increasing at an alarming rate and as a consequence, demand for fish has far exceeded the supply. Fish culture or pisciculture was initially started to supplement these dwindling natural fish supplies. With the implementation of intensive pisciculture programmes or the so-called 'blue revolution', scientists in India are now planning to improve the breed and increase the production of fish by applying different biotechnological methods.

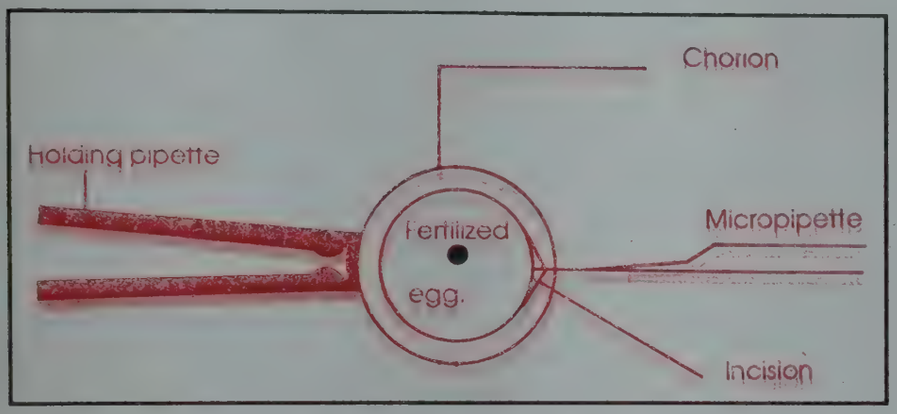


Electron micrograph of fish sperms

Are fish amenable for applying different techniques of biotechnology ? Yes, They do. One of the techniques is to make good use of their sex chromosomes. As in human beings, sex chromosomes determine the sex in fishes; males of majority of fishes have a heterogamous (differing) set of chromosomes. As fish produce a large number of eggs at a time, it is much easier to work on their chromosomes and manipulate their genes. Since the eggs of many fish species are large in size, injection of novel genes of desired characters taken from other animals becomes comparatively easier. In addition, eggs and sperms of fish can be stored at low temperatures for long time. Moreover, by changing the temperature, it is even possible to manipulate the development of fertilized eggs.

Preservation of gametes and embryo at low temperatures (mostly below freezing temperatures) is called cryopreservation. In fish culture operations, it is difficult to obtain a specific sexually mature male and female fish at the same time under favourable condi-

tions. This problem can be overcome by artificial fertilization using cryopreserved sperm. Semen and eggs are normally forced out of fully mature fishes by pressing their abdominal region (stripping method). Only those batches of sperms exhibiting high motility in fresh water are cryopreserved. Samples of sperms are then mixed with some cryoprotectants like glycerol and dimethyl sulphoxide and diluents like ringer's solution, sodium citrate, glucose and lactose. These additives prevent sperms from getting damaged during chilling and also provide the right kind of fluid atmosphere.



The microinjection procedure

Sperms are preserved either for experiments or for mass production. In the former straw-type polythylene tubes (0.5ml) are used as containers whereas in the latter aluminium foil bags(10ml) are used. These tubes and bags are then frozen in liquid nitrogen at temperatures 77^0 below that of ice. When required, these tubes are taken out, warmed up slowly mixed with diluents and used.

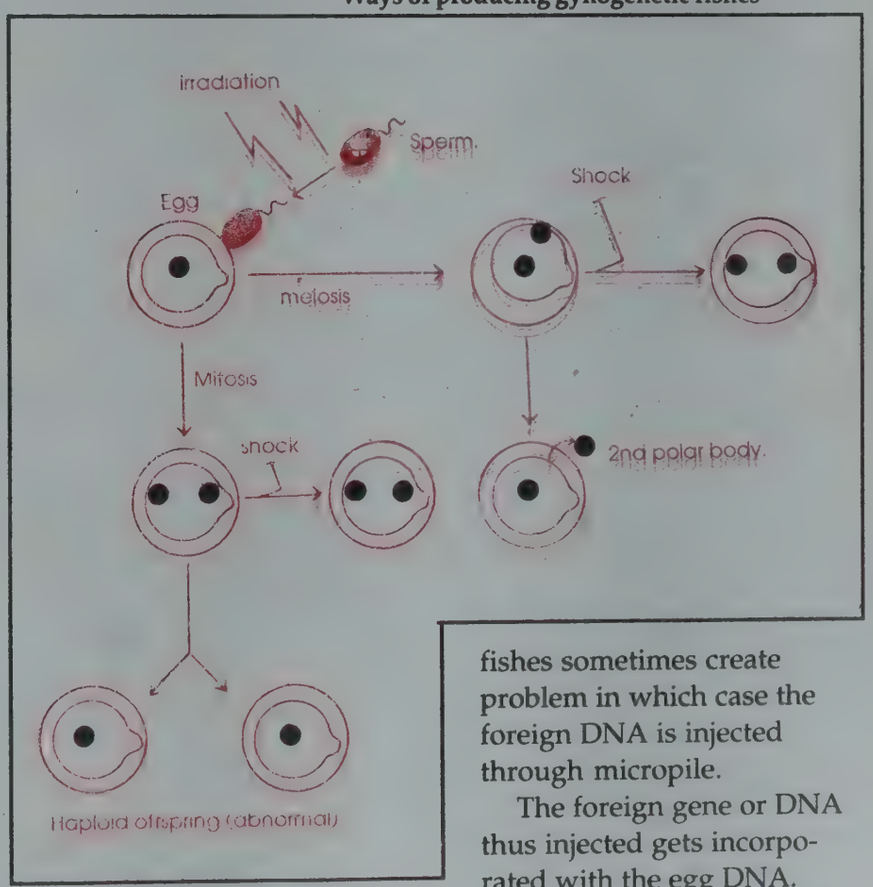
Rapid growth rate, low bone to flesh ratio, high nutritive content, high reproductive potential, and resistance to diseases are some of the basic considerations for selecting culturable fish species. After sexual maturation, the body growth or somatic growth of fish slows down and major part of the energy is used for reproductive purposes. To make such mature fishes meatier, growth hormones are often included in their food or injected. Now, we can select growth hormone genes from other animals and can inject these genes into the fertilized egg. Injection of human or bovine growth hormone genes at early stages of development can prolong the somatic growth. In fact, this technique is one of the achievements of biotechnology in fish genetic research.

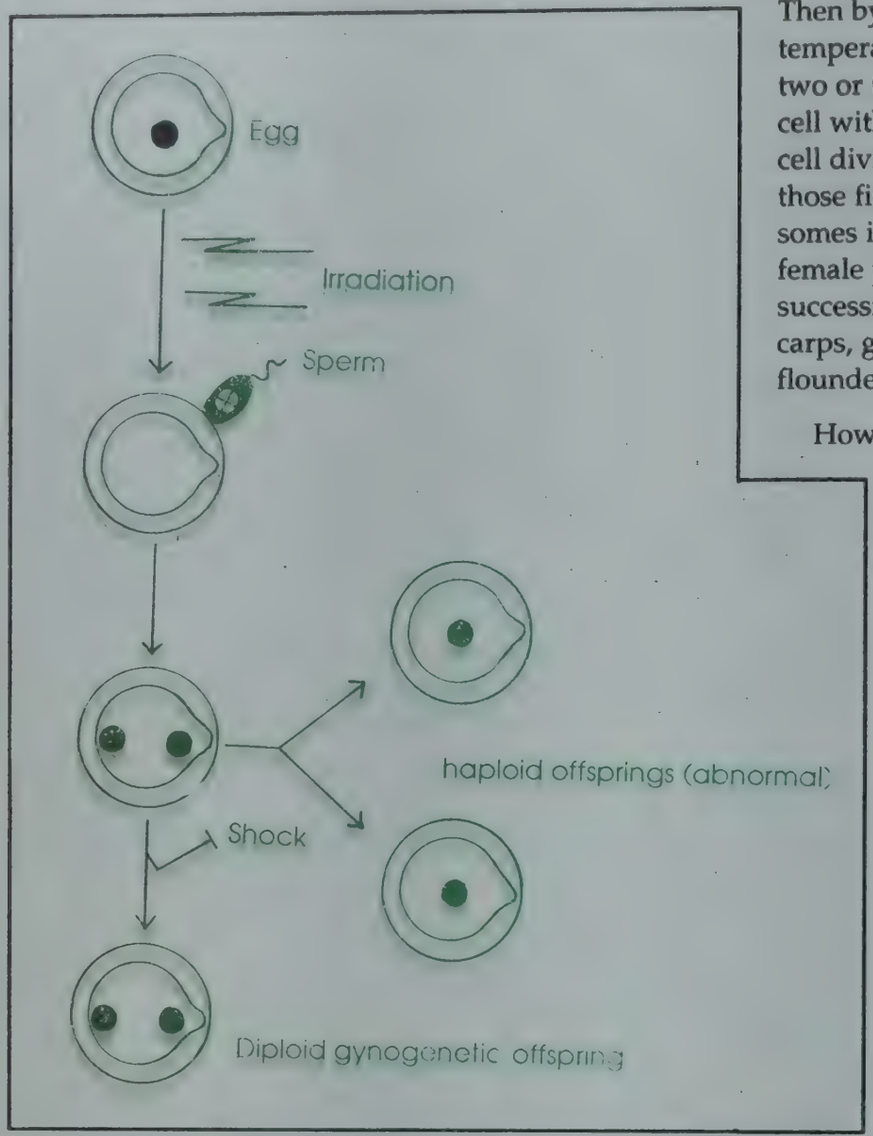
Fishes produced as a result of the injection of foreign genes are called transgenic fishes. Attempts to produce transgenic fish have begun only recently. Recently, Dr. T.J. Pandian and his colleagues at Madhurai Kamaraj University, Tamilnadu, have succeeded in producing some transgenic fishes through gene manipulation. Gene transfer could become a valuable tool for genetic improvement of commercially important fishes.

Injection of foreign genes into fish egg is usually done using an instrument called micromanipulator. It is a device with which one can place the tip of a microneedle or micropipette into any position. Eggs are held by suction at the tip of a holding pipette and a small hole is drilled in the outer membrane of the egg using a metal needle or a broken pipette. Through this hole a micropipette filled with desired DNA solution (for example, human and bovine growth hormone genes) is lowered into the egg. This can be done by precisely adjusting the micromanipulator. The thick outer membrane of egg in some fishes sometimes create problem in which case the foreign DNA is injected through micropile.

The foreign gene or DNA thus injected gets incorporated with the egg DNA. Integration of these foreign genes in fish can be ascertained by sophisticated techniques like Southern blotting and dot plotting.

Ways of producing gynogenetic fishes





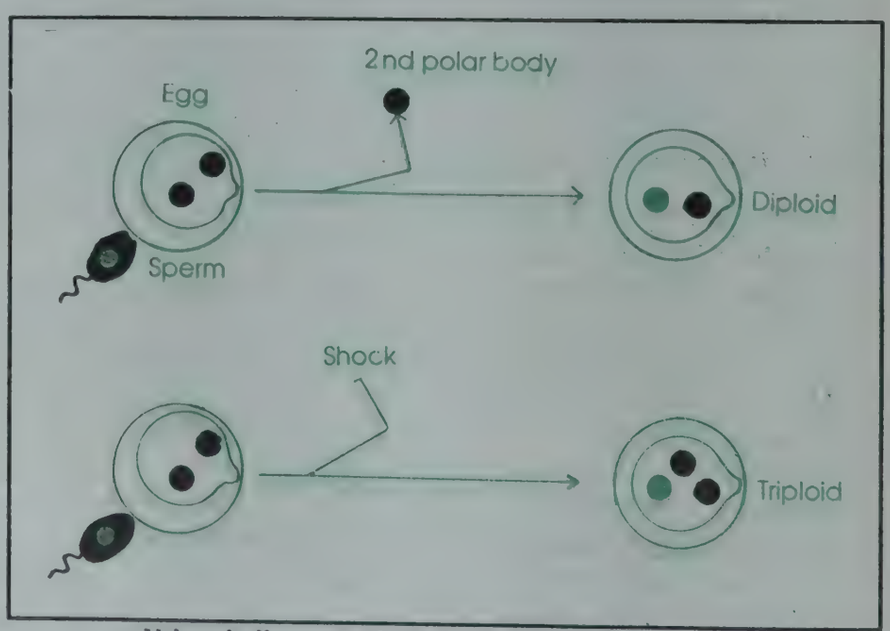
Diploid androgenetic males are produced by killing egg nuclei

One of the major problems in the culture of certain prolific breeding fishes such as *Tilapia* is that the culture systems become overcrowded pretty soon. Monosex fish culture, preferably of only sterile males, has been practiced these days to avoid such overcrowding reproduction. Chromosome manipulation is one of the methods used for obtaining the sterile fish populations. Gynogenesis, androgenesis and polyploidy are the techniques mainly used for producing monosex populations of fish.

Gynogenesis is the development of fishes with only the maternal chromosomes. In this technique the chromosomes of sperms are destroyed usually by ultraviolet radiation. The egg is allowed to be fertilized by such UV-treated sperms. Then by exposing the eggs to sudden changes in temperature or increase in pressure their division into two or the expulsion of second polar body (the smaller cell with a set of chromosomes formed during the last cell division which produced the egg) is prevented. In those fishes females (XX) of which have similar chromosomes in their cells, gynogenesis will result in an all-female population. Gynogenesis has been practiced successfully in fishes like common carp, Indian major carps, grass carp, silver and big head carps plaice, flounder, rainbow trout, salmon and tilapis.

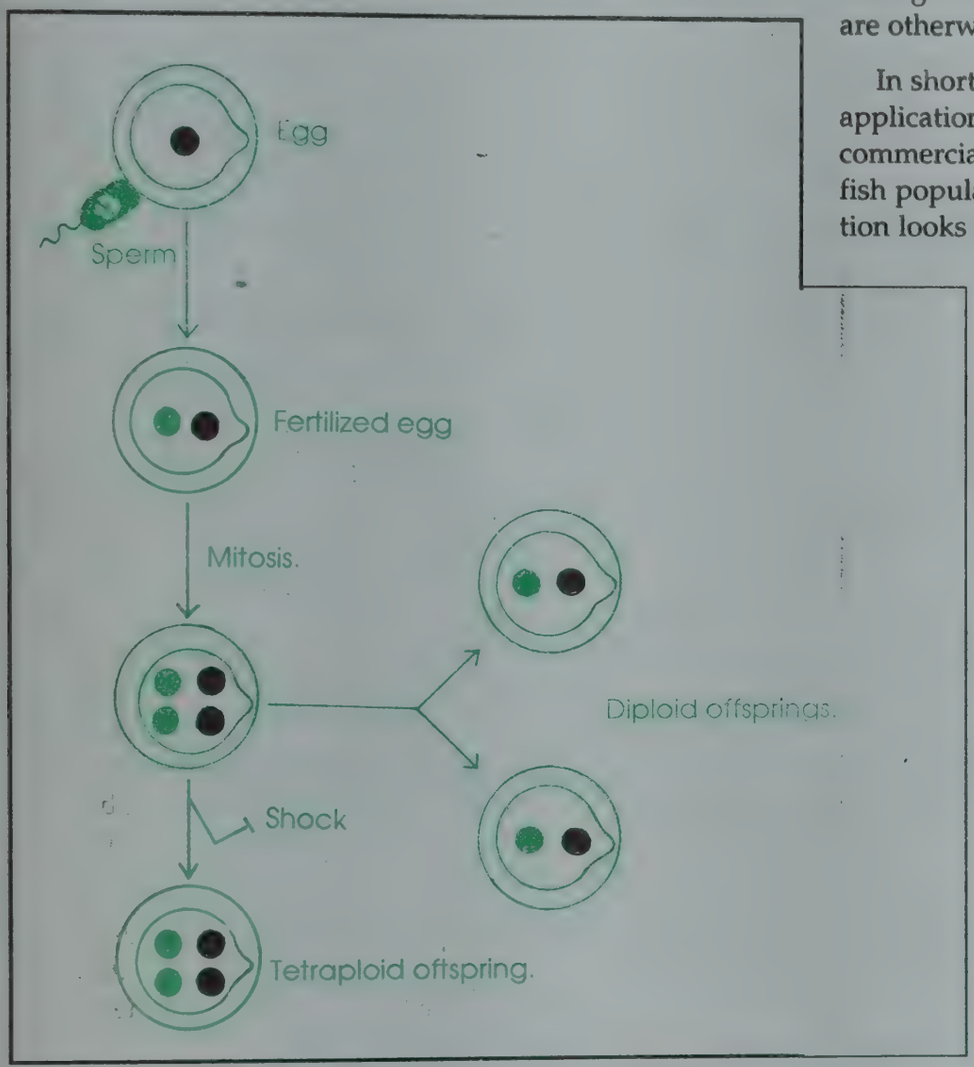
However, in many cases all-male fish populations are preferred, as males generally grow faster than the females. It is then that androgenesis comes to aid. Androgenesis is the phenomenon in which developing fishes inherit only paternal chromosomes. In fish species with homogametic males (males with XY chromosomes) all-male populations can be produced by androgenesis. Here, the entire genetic content of the egg is destroyed by irradiation before fertilization. Thus the developing offsprings carry only the paternal genetic material. As in the case of gynogenesis the single set of chromosomes obtained from the sperm is doubted in the fertilised egg by preventing the division of the cell using by thermal or pressure shocks.

The assumption that the polyploids (fishes with multiple sets of chromosomes rather than two sets grow faster has been the main



Using similar methods triploid fishes are also produced

reason for the interest in fish polyploidy. Triploid fishes (with three sets of chromosomes) fishes are produced by forcing the egg to retain the second polar body after a normal fertilization. This again is achieved by applying thermal or pressure shock, for enhancing fish production. This would also avoid the risk of gene contamination with exotic species.



Tetraploid fish can also be produced by post-fertilization shocks

Tetraploid fishes are obtained by the eggs fertilized in the usual way by exposing fertilized eggs to a shock which will prevent first mitosis. However, unlike the case of triploids, both male and female tetraploids remain fertile. These tetraploid females and homogametic males (XX) can be used further for the production of sterile triploid (XXX) salmons, which can be used effectively in aquaculture. Induction of ploidy in fish could be detected by measuring the size of nucleus in their red-blood cells, by counting or by measuring the DNA and such other techniques.

Mutagenesis is the artificial induction of mutations by irradiation and chemicals. The artificially induced mutations in breeding in fishes are used for replacement of single alleles genes by more desirable ones which are otherwise not available in gene pool.

In short, fish represent an excellent model for the application of different techniques in biotechnology; commercial scale production of monosex or sterile fish populations through chromosome manipulation looks promising for the further intensification of aquaculture in India. Intensification of fish farming makes diseases and parasites increasingly more difficult to control. Some fish stocks are resistant to diseases while others are susceptible. Due to the long contact with a particular pathogen (disease causing agent), disease resistant varieties may have acquired immunity against it. Alternatively, some fish stocks may be naturally resistant to a particular pathogen. Production of disease resistant varieties, particularly against dreaded diseases like dropsy and epizootic ulceratives syndrome (EUS), most common in the fishes of India, is another area where biotechnology can play a significant role. However, this programme has not acquired momentum since it is a long laborious process. Some of the other areas for the application of new biotechnological innovations in aquaculture include cryopreservation of gametes, isolation of gene markers, development of immunodiagnostics based on monoclonal antibodies and DNA probes, development of disease resistant varieties of fishes and production of vaccines against fish diseases. In a developing country like ours, where majority of people suffer from malnutrition, particularly from protein deficiency, intensification of aquaculture programmes or the successful implementation of 'blue revolution' depends a lot on the large-scale use of specific biotechnology package programmes in aquaculture. In fact, it is the need of the hour to use different techniques in biotechnology as potential tools for augmenting fish production.

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ON the occasion of its foundation day (26th September, 1993) the CSIR announced the prestigeous Shanti Swarup Bhatnagar Prizes for Science and Technology. This time the awards were shared by twelve eminent scientists. Young Scientist Awards were given away to seven upcoming young researchers.

Shanti Swarup Bhatnagar Prize Winners

Dr. R. Gadagkar, Indian Institute of Science, Bangalore, and ***Dr. M.R.N. Murthy*** also at Indian Institute of Science, Bangalore, in Biological Sciences.

Dr. S.R. Gadre, University of Poona, Pune, and ***Dr. T. Ramasami,*** Central Leather Research Institute, Madras, in Chemical Sciences.

Dr. U.C. Mohanty, Department of Science and Technology, New Delhi, in Earth, Atmosphere, Ocean and Planetary Sciences.

Dr. Dipankar Banerjee, Defence Metallurgical Laboratory, Hyderabad, and ***Dr. S.K. Bhatia,*** Indian Institute of Technology, Bombay, in Engineering Sciences.

Dr. Karmeshu, Jawaharlal Nehru University, New Delhi, and ***Dr. N.M. Singh,*** Tata Institute of Fundamental Research, Bombay, in Mathematical Sciences.

Dr. G.P. Pal, M.P. Shah Medical College, Jamnagar, in Medical Sciences.

Dr. Gopal Krishna, National Centre for Radio Astrophysics, TIFR GRMT project, Pune, and ***Dr. R. Simon*** of Institute of Mathematical Sciences, Madras, in Physical Sciences.

CSIR Young Scientist Awardees

Dr. Rajendra Singh Sangwan, Central Institute of Medicinal and Aromatic Plants, Lucknow, in Biological Sciences.

Dr. Subhash Prataprao Chavan, National Chemical Laboratory, Pune, and ***Dr. Rukhsana Ilyas Kureshy,*** Central Salt and Marine Chemicals Research Institute, Bhavnagar, in Chemical Sciences.

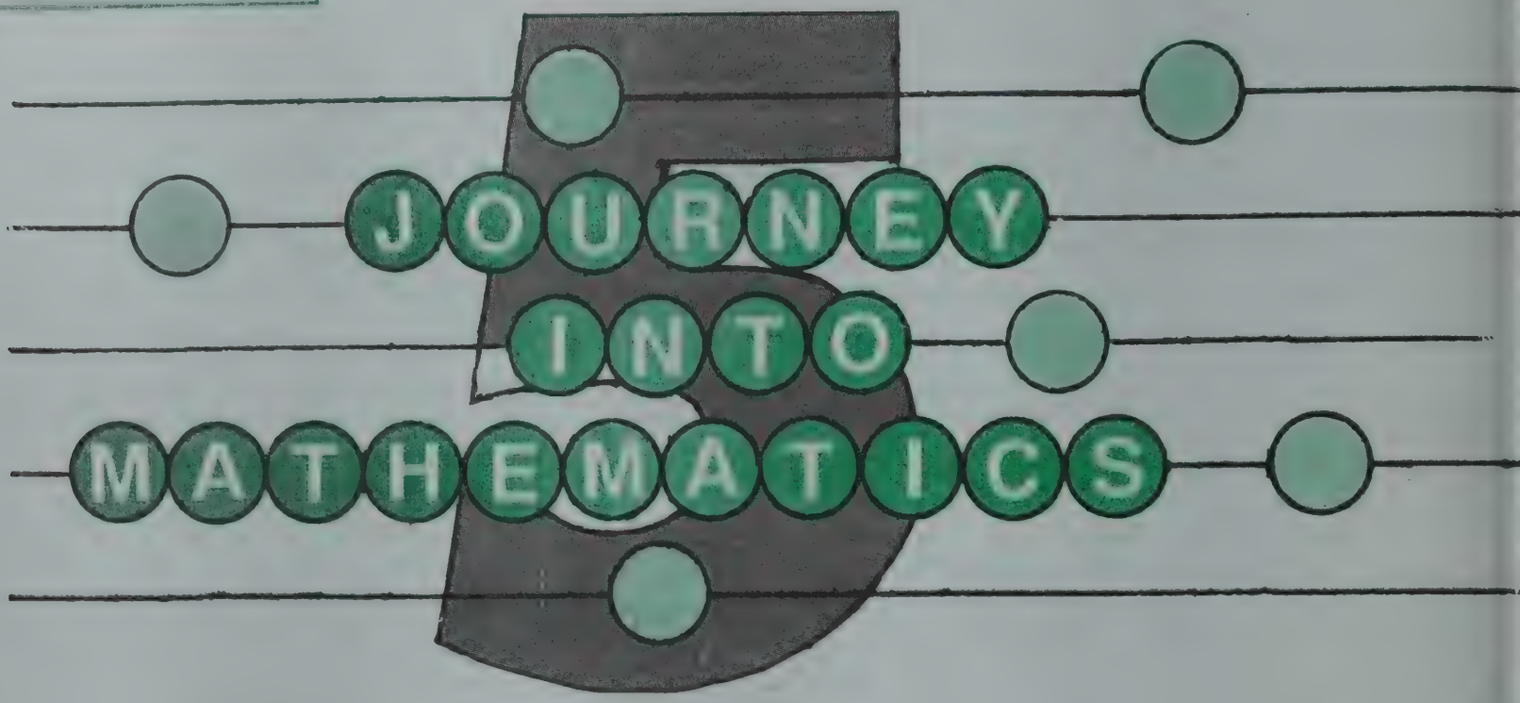
Shri Ashish Kumar Gondal, Engines Laboratory, Indian Institute of Petroleum, Dehradun, and ***Dr. B.P. Naganarayana,*** Structural Sciences Division, National Aerospace Laboratories, Bangalore, in Engineering Sciences.

Dr. Ajay Dhar, National Physical Laboratory, New Delhi, and *Dr. Murali Sastry,* Physical Chemistry Division, National Chemical Laboratory, Pune, in Physical Sciences.

CSIR Special Prize

A special prize of Rs 10,000 was awarded to Master Mohammed Tahseen Ameen, a student of City Montessori School, Lucknow. Master Ameen has developed a robot which won gold, silver and bronze medals in the categories of Arms, Innovation Machines and Robo Dog respectively at the International Robotic Olympics, Canada.

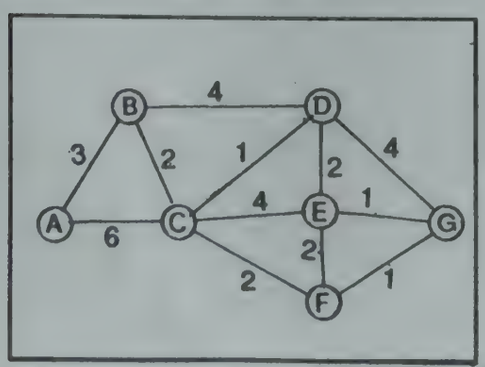
For The Young



Clever Calculations

NAKUL PARASHAR

HAVE you ever thought of the problem faced by travelling salesmen or the courier boys ? Poor chaps. They have to visit a specified number of places which may be scattered all over and they have to do it spending only the amount given to them, or if possible spending lesser (a difficult task, I know, you will agree). Can anybody help them in planning their tours in such a clever way that they visit all places at one go but in an economical way ? Yes, Discrete Mathematics can. For the problem faced by salesmen is sililar to the one concerned with the following graph.



If we have a labelled graph like the one drawn here, then in order to find the shortest path from a particular vertex to each of the other vertices (six in this case) in the graph would require an approach similar to that of Prim's algorithm. (*See* Journey into Mathematics-4). In 1959 the famous Dutch mathematician and physicist, inventor of structural programming language ALGOL, Edger Dijkstra put forward a long-awaited solution to this problem which became a milestone in Discrete Mathematics and, in turn, modern theoretical computer science. This solution, in fact, came as a succour to the worst affected travelling salesmen of those time who used to plan their itinerary either by trial and error by calculating the shortest path for hours. The most modern operational research techniques today too rely chiefly on the principle of optimality which actually is the spine of Dijkstra's algorithm.

Oh! then, if its such an important algorithm, then why delay, let us get on to it right away.

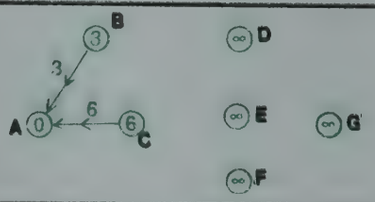
Consider the graph. If we are to find the shortest distance to all other six vertices from A, then we'have got to convert the graph into a reachability matrix which would be

$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \\ F \\ G \end{array} \begin{array}{c} \begin{array}{ccccccc} A & B & C & D & E & F & G \end{array} \\ \begin{pmatrix} 0 & 3 & 6 & \infty & \infty & \infty & \infty \\ 3 & 0 & 2 & 4 & \infty & \infty & \infty \\ 6 & 2 & 0 & 1 & 4 & 2 & \infty \\ \infty & 4 & 1 & 0 & 2 & \infty & 4 \\ \infty & \infty & 4 & 2 & 0 & 2 & 1 \\ \infty & \infty & 2 & \infty & 2 & 0 & 1 \\ \infty & \infty & \infty & 4 & 1 & 1 & 0 \end{pmatrix} \end{array}$$

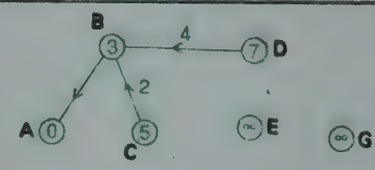
The entries labelled as ∞ denote that there isn't any direct link between these two vertices. During the execution of the algorithm, these shortest paths will be found, one at a time. The vertex whose shortest path to A has just been found will be denoted as *vertex* *. Further, at all times, each vertex will have three attributes assigned to it: a *status*, a *distance*, and a *next* vertex. The *status* will be either "!", meaning that the shortest path from the vertex destined to the vertex initial has definitely been found or "?", meaning that it hasn't. The *dis-*

tance will be a number, representing the length of the shortest path from vertex destined to vertex initial found so far. It's quite obvious that this value might be ∞, meaning that no path has yet been found. The *next* will be the first vertex on the way to vertex initial along the shortest path found so far from vertex destined to vertex initial. If distance at vertex destined = ∞ no path has yet been found, and next of that very vertex destined will be equal to vertex initial. Throughout the execution of this algorithm next of vertex initial is assigned the special symbol "*", the vertex initial's special role. Now onto our example. The following table would provide the initial state:

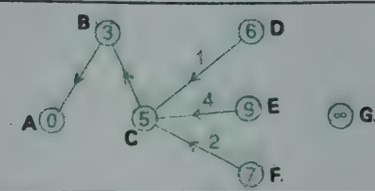
Vertex	A	B	C	D	E	F	G
status	!	?	?	?	?	?	?
distance	0	3	6	∞	∞	∞	∞
next	*	A	A	A	A	A	A



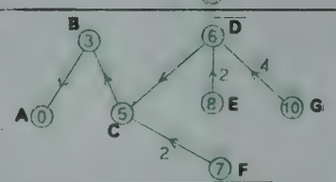
vertex	A	B	C	D	E	F	G
status	!	!	?	?	?	?	?
distance	0	3	5	7	∞	∞	∞
next	*	A	B	B	A	A	A



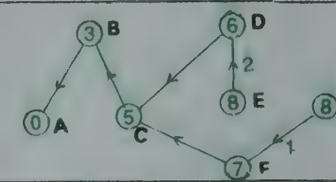
vertex	A	B	C	D	E	F	G
status	!	!	!	?	?	?	?
distance	0	3	5	6	9	7	∞
next	*	A	B	C	C	C	A



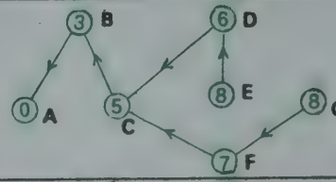
vertex	A	B	C	D	E	F	G
status	!	!	!	!	?	?	?
distance	0	3	5	6	8	7	10
next	*	A	B	C	D	C	D



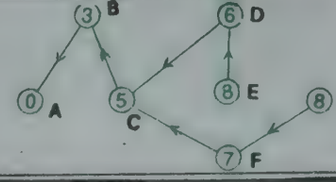
vertex	A	B	C	D	E	F	G
status	!	!	!	!	?	!	?
distance	0	3	5	6	8	7	8
next	*	A	B	C	D	C	F



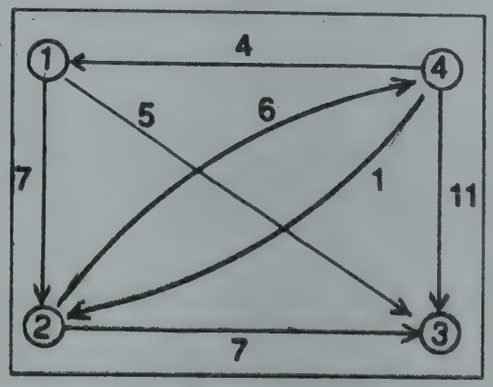
vertex	A	B	C	D	E	F	G
status	!	!	!	!	!	!	?
distance	0	3	5	6	8	7	8
next	*	A	B	C	D	C	F



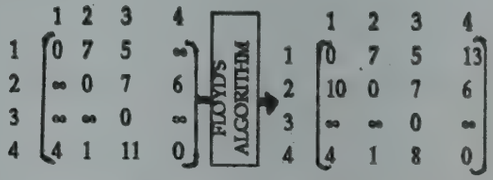
vertex	A	B	C	D	E	F	G
status	!	!	!	!	!	!	!
distance	0	3	5	6	8	7	8
next	*	A	B	C	D	C	F



In our everyday life we often encounter problems that invariably need Dijkstra's algorithm to tackle them but then there is a more direct way to solve the all-pairs shortest distance problem - which is also cost effective in terms of computing time and space. It is calledthe Floyd's algorithm, named after its propounder Robert W. Floyd, an american computer scientist. His approach deals this problem with labelled directed graph and not with labelled undirected, as the Dijkstra's algorithm did. If you like, you can think of the labels as representing the cost of air transportation from one city to another. Everyone knows that the cost of a one-way flight from New Delhi to Tokyo isn't necessarily the same as the cost from Tokyo to New Delhi. So sometimes we need directed graphs. To get alongwith Floyd we need to consider an arbitrary but labelled directed graph, like the one here.



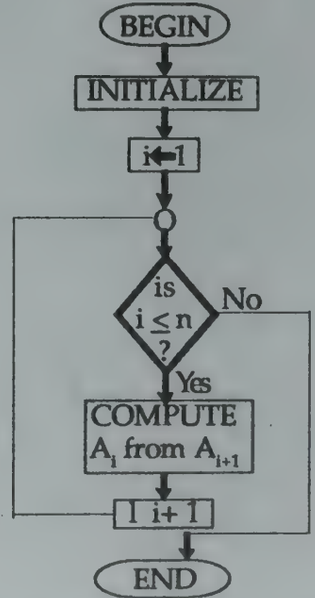
All that is needed by this algorithm is to convert the original reachability matrix into the following form and that is



where Floyd's algorithm is nothing but an iterative formula

$A_i[x,y] = \min A_{i+1}[x,y], A_{i-1}[x,i] + A_{i-1}[i,y]$

based on the following flowchart.



Flowcharts, pseudocodes, algorithms and a lot more of these type baroque Discrete mathematics with a complete set of instructions make this branch a full fledged ancillary of modern computer science. We have been going through trees and graphs and as we move into the deep waters of this mathematics we find algorithms are spread all around.

"But what's so special about algorithms. They are merely ordinary steps to tackle a problem written in such a way that a computer can get instructions from it, isn't it." That's true. What exactly makes an algorithm good? One answer is that any fast algorithm is a good algorithm. Or in other words one which performs tasks rapidly. We admit that being the fastest doesn't mean being the best; other considerations, like memory requirements and simplicity, are often important. But its certainly no great honour to be slow! In fact the criterion to judge how fast an algorithm is can be expressed by *runningtime* which is related to the size of the task the algorithm is asked to perform. Running times for algorithms are like snowflakes; no two are exactly same. Still, we find that running times can be classified into few major categories, corresponding to their so-called *orders of magnitude*. Algorithms whose running time hae small orders of magnitude are considered fast algorithms, and those with large orders of magnitude are considered slow.

Order of magnitude for *running time* has become an essential part of discrete mathematics because software designers heavily rely upon them to improve their algorithms and in turn the efficiency of the computer software packages. Thus these *order of magnitude* statements about running times became so common that a need for a special notation was strongly felt. The *big-0* notation invented by German number theosist Paul Bachman in 1892 was found inevitable for describing the running times of algorithm by the modern computer scientists.

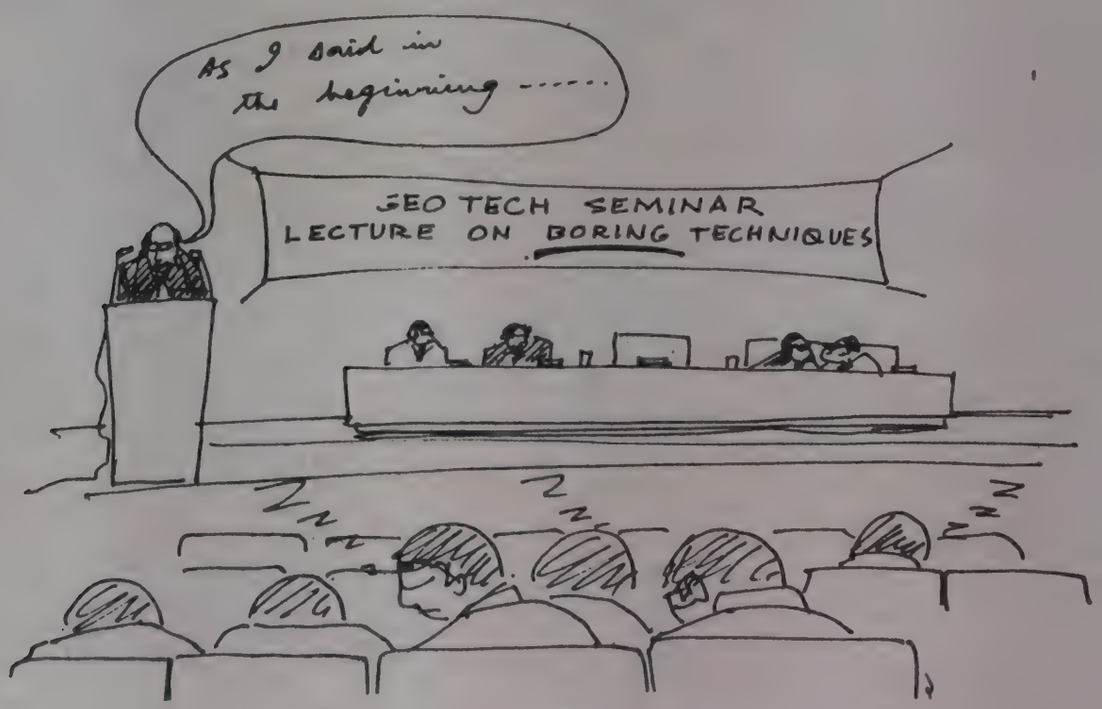
Oh! *Big-0* it is:

"If the actual running time of an algorithm is t (n) and if s(n) is a simple function, like n or n^2 or n^3 or 2^n, we are allowed to say that t(n) has order of magnitude s(n), or that t(n) is big-O of s(n), and write t(n) = O(s(n)),

if t(n) is less than or equal to a constant times s(n), for large values of n."

You might be wondering! All throughout this journey we'have been telling Discrete Mathematics is the computer mathematics, but where's all that jugglery of binary numbs. Don't get disheartened. Our next destination is going to be the propositional maths, the generator of digital technology of today.

Shri Parashar is a scientist at Publications and Information Directorate (CSIR), Dr. K.S. Krishnan Marg, New delhi-110012



"Hope he doesn't repeat the whole lecture !"

Cartoon by ***V. J. Nene, Scientist, CBRI Ext. Centre, New Delhi***

SCIENCE ON STAMPS

KABITA ROY

Exotic Corals

CORALS are perhaps the most appropriate organisms to represent the exotic nature of the sea. These exclusively marine animals that thrive in all warm seas stand apart from other marine animals in many ways. The most important of their properties is that they are dominant constituent of the most luxuriant underwater phenomenon — the coral reef.

People inhabiting the tropical shores normally identify the term 'coral' with the bleached stony heads, often assuming the shape of a petrified tree, which are collected and sold as souvenirs. Few are aware of the fact that these are only the skeletons of tiny and vividly-coloured flower-like coral animals, related to sea anemones, that live in huge aggregations, or colonies. A coral colony is usually initiated by the settlement on a rocky surface of a free-swimming coral larva, called a planula. Subsequently it metamorphoses and produces a polyp that grows and later reproduces asexually, by splitting into two or more daughter-polyps. The polyp may alternatively produce smaller polyps by budding. The earlier polyp ultimately die, and are buried beneath their offspring. The number of polyps thus produced increases gradually reaching in "older" colonies, many millions. Such colonies attain a size of several metres, and form a continuous organic cover over an inert massive skeleton.

Several hundreds of coral species have hitherto been recorded from the seas. Bewitched with its beauty and exotic colour many Postal Departments issued stamps on these gems of nature. On December 21, 1992 Malaysia issued a strip of five 30c value stamps and a souvenir sheet bearing a $2 stamp. The second from left stamp features 'Dendronephthya' coral group — the soft corals. These corals are characterized by an inner skeleton composed of chalky spicules embedded in soft tissue. The structure of 'Dendronephthya' often resembles that of land plants — long branched stems, adorned by minute flower-like polyps.

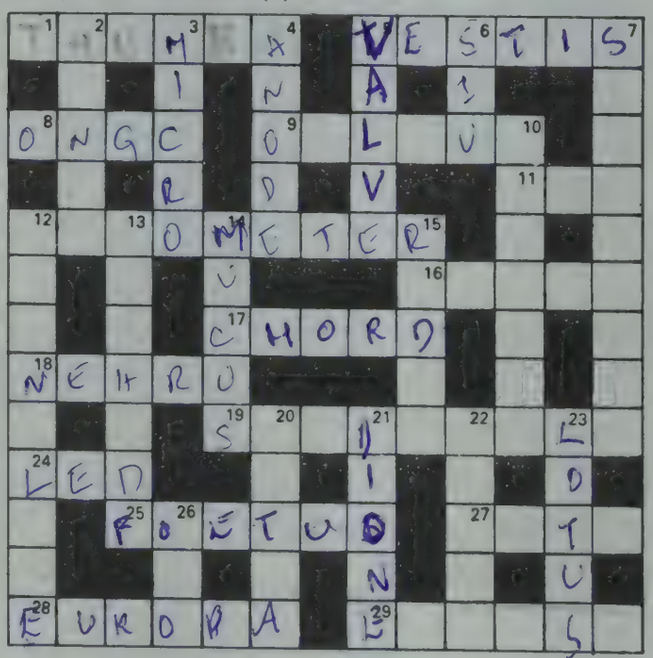
The third stamp depicts 'Dendrophyllia'. The stamp shows the flower like yellow or orange polyp of a Dendrophyllia coral feeding at night. These corals tend to grow in large colonies on coral cliffs or underwater ledges and a diver shinning his torch towards the corals experience a blaze of colour in an area which in the daytime can be rather dull. Papua New Guinea's set featuring four coral species was issued on November 9, 1983. Many more species are available on a large number of stamps. Till then happy hunting !

CROSSWORD

VIJAYA KHANDURIE

ACROSS

1. A village near Trivandrum, site for rocket launching station (6)
5. A internal organ, like the heart, lung, etc (6)
8. Abbreviation for the Indian organization responsible for the exploration of oil and related activities (1,1,1,1)
9. A device used to allow a constant and uniform dripping of oil (6)
11. Abbreviation for limit as used in differential calculus (3)
12. An instrument for measuring very high temperatures, as in furnaces (8)



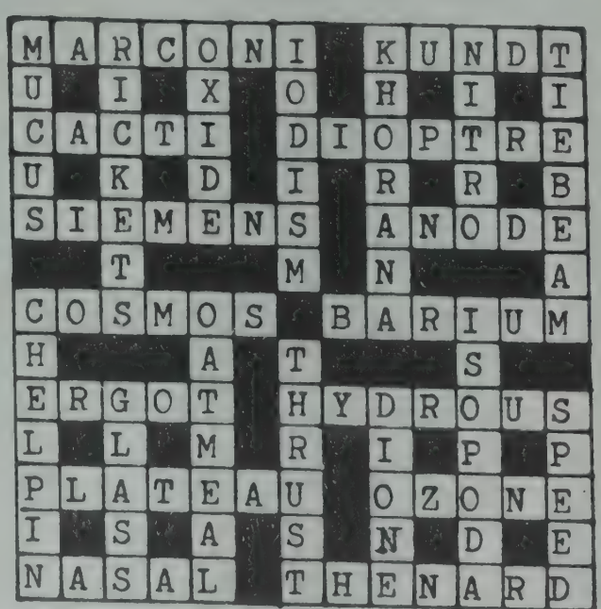
16. Latin prefix meaning 'between' which is used with many scientific terms (5)
17. A straight line drawn between two points on a curve (5)
18. Surname of the Indian Prime Minister who said "Planning is science in action" (5)
19. A device for the mechanical performance of the arithmatical operations (5,4)
24. Abbreviation for the digital display comprising two glass sheets separated by a sealed-in crystal material (1,1,1)
25. Animal in process of development from fertilized ovum (6)
27. Latin prefix meaning 'whole', 'all' (4)
28. A satellite of Jupiter, named after a continent (6)
29. Forename of the physicist who developed the cyclotron (6)

DOWN

2. _____'s law : The amount of a gas absorbed by a given volume of a liquid is directly proportional to the pressure of the gas at a given temperature (5)
3. _____tome : An instrument for cutting thin sections of specimens (5)
4. Positive terminal of a battery (5)
5. Any device which controls the passage of fluid through a pipe (5)
6. 'Systeme International d'Unites' (1,1,1)
7. _____cable : Long-distance cable laid along the sea bed (9)
10. _____slope : The ratio of the percentage change in count rate for a constant source, to the change of operating voltage (7)
12. The bivalent radical -C_6H_4- (9)
13. A needle-shaped crystal, like that of calcium oxalate (7)
14. The viscous fluid secreted by mucous glands (5)
15. The summit-line of a roof (5)
20. A free-living embryo (5)
21. A satellite of Saturn which is heavily cratered (5)
22. Quantum of rotational energy analogous to the phonon (5)
23. A type of tropical water-lily (5)
26. Reciprocal of the ohm (3)

(Solution in the next issue)

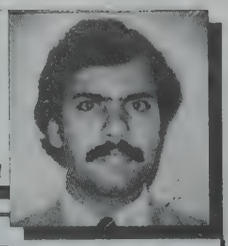
Solution to October Crossword



Shri Khandurie is a science-educationist. Address : 23-L, Sector IV, D.I.Z. Area, Shahid Bhagat Singh Marg, New Delhi-110 001

How to Use More Mind Power for success in competitions

(Most people use only 10 %) *by Raj Bapna*



• Remember more in less time • Improve your concentration • Read faster • Get more marks in exams • Develop self-confidence • Avoid mistakes

My name is Raj Bapna. I want to tell you about my new 224-page *surprisingly powerful* course "Raj Bapna's Mind Power Study Techniques" for *your success*.

Why Use Only 10% Mind Power ?

Scientists have found that most people *use* only 10% of their *mind power*. So, upto 90% of the mind power remains hidden and unused.

And yogis have always known this.

If you *learn* to *use* more *mind power* to study, you can remember more in less time. So, your chance to *get success* in competitions can greatly increase.

My proven, result-oriented *course* will *help you* in everything you want to *study*: **Chemistry**, **English**, **History**, etc. and for **IAS**, **PMT**, **IIT**, **Board Exams**, **PO**, **Bank**, **UPSC**, **SSC**, etc. My course will *help* you to make the best use of your hard work and *your* coaching/studying for *success*.

Surprising But True

You have been learning many subjects in schools or colleges for 10, 12, or 15 years. It is surprising that, even for one hour, they do not teach you how to use your mind power and how to *study for success*.

What Will You Learn

You will improve in the following 9 ways:

1. Good increase in your memory and concentration **2**. Small to moderate improvement in your intelligence **3**. You will not be required to study for more hours, but your ability to study longer without getting tired or feeling sleepy will increase **4**. Your effectiveness to read and learn will increase greatly **5**. You will experience that you are capable of achieving much more than you currently do (yes, even if you are a topper) **6**. Set realistically high aims/goals and take you step by step on the road to achieving them **7**. Improve your writing, spelling, interview skills **8** Learn exam secrets to get more marks for what you know **9**. Avoid serious mistakes that lead to failure.

Can't Make You Superman. No Magic.

I want to make it clear that my course can not *make you* a *superman*. Similarly it can not *give you success by magic* if you do not work hard. Similarly it can not *make* everyone a *topper*.

What my course can do is to teach you to study and remember more in less time, to read faster. And as a result you will become more efficient than 99% of students. So your chance to *get success* in exams and competitions will greatly increase.

I guarantee that my course will help *you* to *get success* if you study average or more and if you are ambitious and very seriously want to *get success*.

Read Faster to Revise More in Less Time

Everyone can learn to read and understand 300, or 500 or more words per minute. But, many of us read only about 100 words per minute.

You will learn my easy Finger Technique in 30 minutes that will prove to *you* that you can *double your reading speed*.

The best use of reading faster is not to learn new things for the first time, but to revise again and again quickly so that you can remember more in less time. (Why? See Memory section below.)

PROOF of Reader's Success

- I am very happy to inform you that my son Ravi Anand increased his reading speed from 228 to surprisingly high 1818 words per minute. Thank you for your course. — *Dr M L Singh, MBBS, MS, Eye Surgeon, Bihar*
- I topped the DAV College Chandigarh. I increased my reading speed from 303 to 1000 words. — *Sanjeev Dixit, Panchkula, Haryana*
- Very useful for my B Sc and ICWA examinations. Within a single day, I increased my reading speed from 275 to 455 words per minutes. — *S Jayaprakash, ICWA student, Madras, Tamil Nadu*
- Unbelievably, I improved my reading speed from 75 to 200 words per minute. My son (in class 4) improved his memory. He also improved his reading speed from 45 to 100. — *Prof M Bhatnagar, PhD, Formerly in USA*
- It is lucid, simple, powerful. — *Prof I J Nagrath, Deputy Director, BITS Pilani*
- Excellent course... it has changed my life style. Increased my reading from 86 to 303 words per minutes in 5 days and strengthened my dream of success. — *Dr Ratnakar Sahoo, Medical College Orissa*

How to Improve Your Memory Quickly

The brain has two memory stores: short-term and long-term. Whatever you see, hear, or feel is processed by the brain. The irrelevant information is removed immediately. The remaining information goes into short-term memory. Whatever we revise again and again goes into long-term memory.

Can You Answer These 6 Question?

- For better memory, should you study early in morning or late in night?
- For better memory, should you read fast or slow?
- Do examiners give more marks if you write more and fill more pages?
- Which vitamins can help your brain function better and improve your IQ?
- Should you study continuously or take rest?
- Why does eating before an exam reduces IQ?

Research shows that without revision, in 24 hours we forget 82%. So, we remember only 18%.

As time passes without revision, we remember less and less. After one month we remember about 5%. Most people attend classes or make notes, but they do not revise enough, so they do not remember as much as they can, and their hard work is wasted.

My course will teach you a systematic technique to revise and remember more in less time. You can learn this powerful technique in just 30 minutes.

As a benefit of reading this, from today, you should revise more to remember better.

Unique Course

My unique course combines the 5000 year old techniques of India with the latest scientific discoveries in brain research, nutrition, psychology, and music in America and other countries. So my course is very powerful.

I teach no theory. Only the practical techniques that have proved effective for myself and other students. My course is in easy language with 61 diagrams so that *you* can understand easily and learn quickly and *get success*.

Newspapers Say This Course Is ...

- Simple, effective, practical techniques to improve overall intelligence and mind power. Even average student can easily understand. — *Times of India*
- Powerful, practical, easy. It will help all students, bank officials and others appearing for test, exams and interviews. — *Indian Banks' Asso. Bulletin*
- It teaches how to succeed in exams and life-struggle. — *Malayala Manorama*

13 Powerful Chapters

1. Learn two mind power study techniques in one hour and quickly improve your study efficiency • The Finger Technique to improve your reading speed quickly: proof that you are capable to achieving much more than what others have told you • The Daily Routine: your guide to super success

2. Exam secrets for getting more marks • Do not eat just before an exam • How do examiners correct answer papers, and how to use this knowledge to *get more marks* • Mega-vitamins can *increase your intelligence* temporarily during exam-days • For these 2 types of questions, you can even fool the examiner and get more marks • 4 more topics

3. Read faster • Understanding and taking care of your eyes • Experience your mind power as a magnet • Expanding your peripheral vision • 2 more topics

4. How to improve your memory in a surprisingly easy way • Systematic Revision and Deafly Routine: The easiest and most powerful memory techniques • 4 more topics

5. Interview techniques for self-confidence and success • Interviews, group discussions, and public speaking • How to develop confidence for interviews • 2 more topics

6. Some techniques for improving memory, concentration, and intelligence • Take these vitamins to *improve* the functioning of your brain and your body • How to sleep well • Alpha Breathing for relaxation • Meditation: an ancient technique for more brain power • Use Sri Yantra for developing your mind power • *Increase your intelligence* by Image Streaming • 5 more topics

7. How to use time in the classroom for success • How to get more marks in practical, internal, or laboratory exams, without any extra word? • How to benefit from your classmates' hard work • 6 more topics

8. Mind maps: a new scientific way to take memorable notes • Key concepts and key words: nature of memory • Memory key words and creative key words • The best way to take notes • 6 more topics.

9. Program yourself for success by using the power of beliefs, imagination, and Neuro Linguistic Programming • Entering the learning state • Anchor yourself for success while watching TV or films • Using music and relaxation for mind programming • Changing beliefs and habits by using NLP • 4 more topics

10. Advanced memory techniques to remember long sequences, spellings, and complicated things • The number-shape technique • The secrets of memory techniques • How to remember spellings • How to enrich your vocabulary • 2 more topics

11. Some major mistakes in exam-days and how to avoid them • 3 topics

Author's BIO-DATA

- B E, BITS Pilani. M Tech, IIT Kgp. NTS scholar. Rank 5 Raj High School Board.
- The maximum the USA companies paid for me in a single month was $18,002 (over Rs 5 lakhs in one month). At peak of success, I left USA to return to India to teach my mind power study techniques. Now I spend my full time to research Mind Power in India.
- World-famous author. Published 3 books in USA including my best selling book " Tricks of MS-DOS Masters", 721 pages, $27.95.
- Increased my reading speed from 72 words to as fast as 1037 words per minute.
- My first job as an engineer paid only Rs 1000 per MONTH. Finally, I earned $50 (Rs 1500) per HOUR in USA as a computer expert.
- Expert in computers, mind power, study techniques. Spent $1300 (about Rs 40,000) for 2 seminars in USA to learn the mind power techniques called Neuro-Linguistic Programming. Was a member of Society for Accelerated Learning & Teaching, USA.
- Learnt French, Sanskrit, Karate, Breaking wooden board by hand, many Meditations, etc.

12. New research in brain science shows that you are more capable than you think • Superlearning • Mind machines and computer meditation • 3 more topics

13. 32 important questions & answers

I Lost A Big Chance. You Should Not.

I wanted to take the best course for IIT entrance. I was not *sure* if the *course* would *really help* me. So, I did not *order quickly*. After waiting for 3 months, I *ordered* the *course*. The course was good and it helped me get rank 1102. I lost a big chance to join BTech in IIT because I did not *order quickly* and waited for 3 months.

You should not lose any big chance. *Order* this *course quickly. Order it now.* You will *feel good* knowing that *using my course* will help you to *get* better education, better job/career, and *more money*.

This course is in 4 volumes, so that your brother/sister can also benefit at the same time.

Think About This

To get success in today's tough competitions, it is not enough just to work "hard". There are only 24 hours in each day. So, you can not study many more hours than others. Learning new and powerful study techniques to become a quick learner with a better memory is the only solution.

My promise may appear to be opposite of what the other people have told you again and again. But, then, how many of those people are NTS scholars, rank holders, World-famous authors, and how many of them ever earned Rs 1500 per hour.

31-Day No-Risk Money Back Guarantee

Use my course for 31 days. If *you* do not *greatly benefit* (read faster, improve memory etc.), simply return the course for your money back (less postage, handling). No questions asked.

There is no risk on your part.

You probably *realize* that 31 days is more than enough time to *benefit greatly*. Actually, many people benefit on the first day they get this course. And most people benefit within 1 or 2 weeks.

This course is never sold in any shops

~~Rs 135.~~ Now Discount Fees Rs 95. Save Rs 40. Postage Also Free.

The fees for this complete course in India is Rs 135 (Rs 540 in USA). But only for now to introduce this course, **the discount fees for this complete course is Rs 95 only**. The postage is also free for Registered Post. This is the last chance to save Rs 40 and postage. So, *order today*.

You can *order* my *course* in two ways: (1) Send total fees Rs 95. **OR** (2) Total fees for VPP is Rs 105, pay Rs 35 as advance, and pay remaining amount to postman when you *get this course* by VPP.

As part of this course, you will get a green colour poster of "Bapna's Optical-Illusion Technique™ for Concentration". This poster was inspired by a 5,000 year old symbol of India which the yogis have been using to improve their concentration and mind power.

Keep this poster free as my gift even if you return the course for your money back. *Take advantage* of this unique offer and *order today*.

So, *go to* the *bank or post office*, make your M.O. or Bank Draft payable to Mind Power Research Institute Pvt Ltd, payable at **Udaipur (Raj)-313001**. Then *send it quickly* to:

Director, Mind Power Research Institute Pvt Ltd
E-11 Mind Power Chambers, Sector 4
Udaipur (Rajasthan) 313001

Please write your name, full address in CAPITAL letters in English. Please write your address (1) in space for Communication at the bottom of the MO form **OR** (2) back side of DD.

TEST TUBE GARDENS

HORTICULTURE: the science of growing plants. Gardeners and foresters alike have been studying methods of improving plants, controlling their growth, changing their qualities. In the past, they managed the propagation of plants with special or induced qualities: taste, scent, beauty, produced through the slow and unreliable process of continuous hybrid breeding. The modern techniques of *in vitro* culture of plants allow plant growers a fast, efficient and detailed capacity to change plant qualities.

To propagate a plant selected for its agronomic qualities, its taste, its scent, its beauty and its sanitary qualities; to conserve "healthy strains" - this perennial gardener's dream has become a reality with *in vitro* culture. Apart from their revolutionary aspects in relation to science and horticulture, *in vitro* culture techniques make it possible to accelerate and redefine plant commercialisation.

Invitro techniques help in getting better breeds, faster

"*In vitro* techniques" signify here all methods of culture, in sterile conditions and on synthetic media, of plant fragments (meristems, buds, tissues or cells) with a view to propagating or improving plant species. Although A. Carrel had achieved, at the beginning of the 20th century, the *in vitro* culturing of embryonic chick tissues, it was not until the years 1935-1940 that, simultaneously in France and in the United States the first successes with *in vitro* plant tissue culture were

mentioned. In 1951, G. Morel and C. Martin, of the National Institute for Agricultural Research (INRA), France, working on the sterile culturing of meristems, achieved for the first time achieved the cure of virus-infected plants and the regeneration of healthy plants from a sick one. These research scientists verified the hypothesis of meristem immunity to viruses put forward in 1952 by two French virologists (Limasset and Cornuct) and achieved the cure of a dahlia infected by three different viruses. They repeated this success by literally saving the Belle de Fontenay potato variety, whose tubers, consumed to the present day, are descendants of plants cured by means of *in vitro* meristem culture in 1955.

Practically any plant fragment can be cultured on synthetic media supplying it with substances necessary for growth and development (mineral salts, viamins, sugars, amino-acids,...). These substances being also favourable to fungi and bacteria, plant fragment culturing has to be performed in totally aseptic conditions and transplanting operations carried out in sterile rooms. Progress in the finer understanding of plant physiology and genetics, accomplished over the last 25 years, makes possible the culturing of structures whose size and degree of organization are more and more limited. Apart from embyros, it is thus possible to culture isolated organs such as buds, roots and leaves. It is also possible to culture plant tissues (epidermis, pith, ...) which very often proliferate to form undifferentiated cell clumps called calluses. These calluses can be maintained in proliferation by successive transplantings. Finally, it is possible to culture cells and, more recently, even protoplasts, the plant cells without their walls have also been cultured. These different techniques have today left the laboratories of basic research and are being applied industrially in the horticultural and agricultural fields.

Orchids were the first plants to be propagated by the new technique

Plants are cultured in controlled conditions in germ free sterile rooms.

In certain special conditions, the embryo contained in seed is not able to develop normally. This is notably the case when different species are crossed and there is incompatibility between the embryo and the maternal tissues. This is also the case in the hybridization of very fast-growing peach varieties. The embryos so obtained are incapable of developing naturally on the tree.

It is possible to culture these embryos*in vitro*, after their teguments (the tough seed coats) have been excised. The process enables the embryos to develop into vigorous plantlets. The first industrial application of this technique was on orchids. When and orchid meristem is cultured, it develops and forms protocorms identical to those obtained during embryo germination. These protocorms can be divided into pieces. From each fragment new protocorms can be regenerated and plantlets obtained. First used in France, this technique is now used by orchid growers all over the world. *In vitro* plant propagation was then adapted for herbaceous species such as carnations, gerberas, ficus, syngonium, and so on. More recently, it was adapted for fruit, ligneous (pulp giving like bamboo), ornamental and forest species.

Professionals distinguish four main phases in the technique; establishment, proliferation, rooting and acclimatisation.

Establishment is the culturing of meristems or buds taken from an original plant selected for its sanitary qualities and its agronomic performances. After approximately a month of culture, they develop leafy shoots which are the starting point for propagation.

Then comes *Proliferation*. The small leafy shoots are transplanted onto a propagation medium enriched with cytokinins (a kind of hormones). Due to the effect of these budding hormones, the axillary buds of each leaf will develop, and, after remaining three weeks in sterile culturing rooms, they form a tuft of 4 to 10 shoots from 1 to 2 centimetres in height. The tufts are then divided into fractional parts and each of the new shoots is transplanted onto a new medium. The propagation process can in this way be repeated during several culturing cycles. From a single rose-tree bud it is possible, for example, to obtain in a year approximately 200,000 plants which are true copies of the original mother plant. *Rooting* is the next step. When the desired number of shoots are obtained, the "microcuttings" are placed on a different nutritive medium enriched with auxins and called a root formation medium. Roots emerge within 15 days. At this stage the young plants, measuring a few centrimeters in height and presenting 3 to 5 roots are perfectly constituted and functional. In the last step called *acclimatization* the young rooted plants are removed from their culture medium and transplanted into a sterile horticultural substrate. They are then progressively "weaned" and cultivated in a green-house for two to three months before being commercialized. The process of acclimatisation makes it possible to propagate a plant selected for its agronomic qualities, its taste and its scent or for the beauty of its foliage and flower, producing several thousand copies in a few months witout climatic risks. It also helps to obtain plants of a high sanitary quality, with earlier and more abundant flowering and having a more bushy and luxuriant development. It is easy to conserve "healthy strains" in sterile

jars and thus constitute veritable plant conservatories. Lastly, it is possible to accelerate the marketing of new strains often selected after long years of experimentation and to imagine new types of products and rethink traditional methods of plant commercialisation.

In comparison with animals, plants possess an essential characteristic; the ability to regenerate whole plants from tissues or cells. This regeneration can be achieved in two different ways. First is by bud neoformation on differentiated tissues, followed by obtaining a leafy shoot after replanting. Rooting must then be induced in the shoot. This technique is already known and used for many plants including gerberas, ficus, begonias, saintpaulias, leeks, and cauliflowers. The second is by embryo formation directly from somatic (non-sexual) cells. This spectacular method has already been successfully practised on coffee oil palm (Orstom-Unilever), carrot, grape vine, rose, and many other plants. When plants areregenerated from organized tissues with little or no passing by the callus state, the plants produced are sufficiently homogeneous. Although at present these techniques are mastered for only a limited number of species, considerable research work is in progress, for this procedure could lead to a spectacular increase in plant propagation productivity and

a real industrialisation of *in vitro* propagation methods. The somatic embryos may be enrobed in a matrix assuring them protection and providing a nutritive source. True artificial seeds will then be obtained. Plant regeneration by bud neoformation or somatic embryogenesis can also be achieved from undifferentiated calluses. In this condition, the genetic programme is not "read" in an exact manner and interesting variants, from the selection point of view, can be obtained. It is only necessary to cite

the research aiming to select pear and apple variants resistant to bacterial destruction, coffee resistant to blight, grape vine resisant to eutypiose, date palms resistant to fusarium, for an appreciation of the economic and ecological significance of research work undertaken in France and now, many other countries.

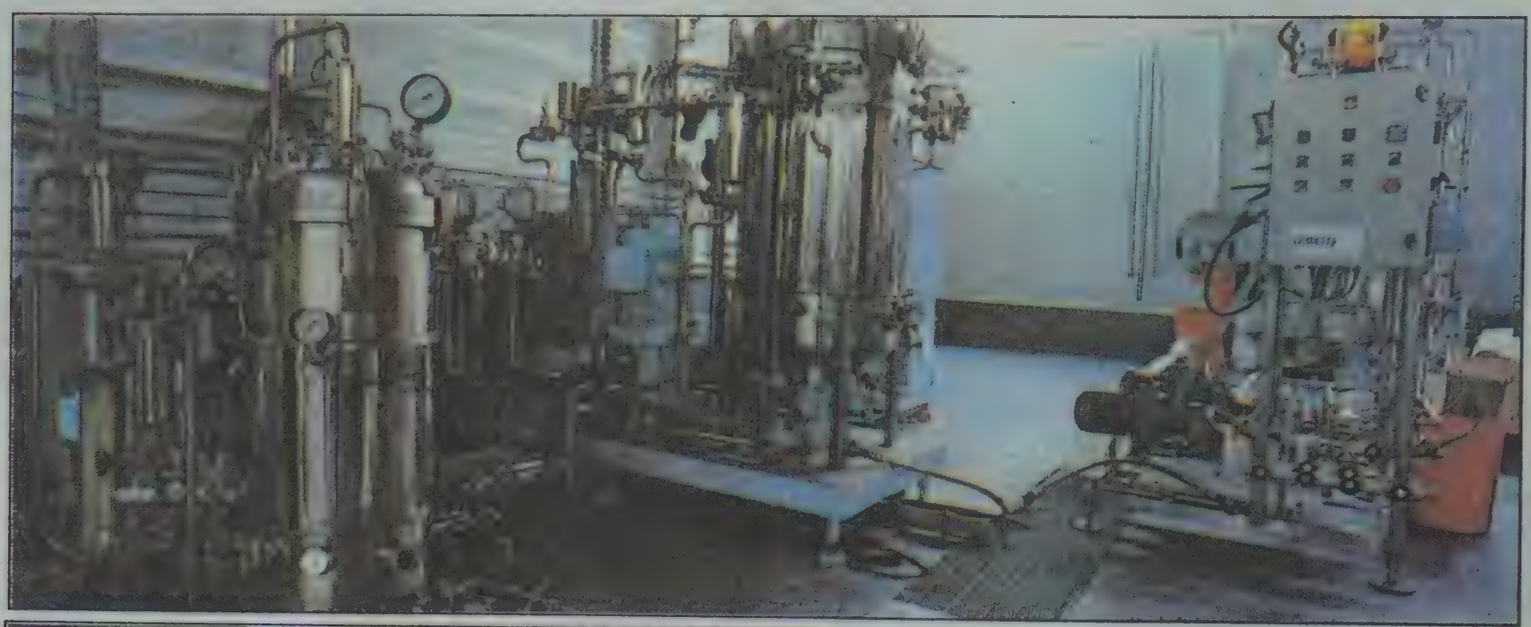
Twenty-five years ago, the culturing of anthers and datura pollen grains enabled eh Indian scientists Guha and Maheshwari, and the French scientist Nitsch, to obtain haploid plantlets. Since then, the number of species in which haploid plants have been obtained, from male sexual cells (rice, tomatoes, petunias, wheat, asparagus...) as well as from female sexual cells (barley, gerberas, lettuces, sunflower, etc.), is on the increase. These haploid plants, often sterile, can be "doubled" after chemical treatment. Thus they will come to possess two identical copies of each of their chromosomes and will then constitute pure lines. These methods, called haplodiploidisation, led recently to the launching in France of the first wheat variety resulting from *in vitro* techniques: Florin*.

Somatic embryos of wheat (top) and carrot (bottom)

Progress made in mastering techniques of plant generation from cells has led research scientists to modify the genetic information of these cells, then to regenerate new plants from these modified cells.

The most known genome modification is that provoked by mutations, in other words modification of the DNA, the carrier of genetic information, by physical (gamma, X and other rays) or chemical agents. This is often used by selectors on plant fragments and especially on buds (rice, wheat, apples, roses. When work is performed on isolated cells, mutagenesis efficiency is considerably improved, since plants regenerated from mutant cells will totally express the mutation without appearance of chimeras, juxtapositions of tissues having undergone mutation and normal tissues. It is also possible to carry out *in vitro* selection of these cells according to their resistance to diseases, or growth conditions, and to regenerate only the resistant cell strains. This considerably reduces the means necessary for selection in the fields (surface area, selection time, personnel costs...). Another way of modifying genetic information is the introduction of "foreign" genes issuing from another species or even from bacteria. Only yesterday the possibilities offered by genetic engineering seemed to belong to the distant future. Concrete results were recently obtained with the introduction of genes resistant to certain herbicide and certain insects. In this way, research scientists at Calgene and Monsanto successfully introduced a resistance gene to glyphosate (a powerful herbicide) and then regenerated cotton, tomato, and colza plants. This induced resistance is stable and transmitted to progeny. In Belgium also, research scientists at Plant Genetic System successfully introduced into tobacco cells a bacterial gene coding the fabrication of a

protein toxic to insect larvae. Plants regenerated from these transformed cells turned resistant to the insect and this gives cause to the hope that it will soon be possible to reduce insecticide treatment of crops drastically. Plant cells differ from animal cells in that, in addition to the supple membrane surrounding them, they possess a rigid wall which excludes all cell combination. Protoplasts, plant cells divested of their walls, can be obtained only after destruction of these walls by enzymes. This technique is now perfected for numerous species and it makes possible the combination of protoplasts of very unrelated species as well as the absorption of macromolecules or even cell organelles. The most striking example, is the creation of somatic hybrids between the tomato and the potato (pomato). Protoplast combination is thus a new tool making it possible creation of new plant species.



Plants grown *in vitro* are later placed in greenhouses (top). Sometimes useful chemicals are also obtained by plants cultured (middle) by using delicate technique (left)

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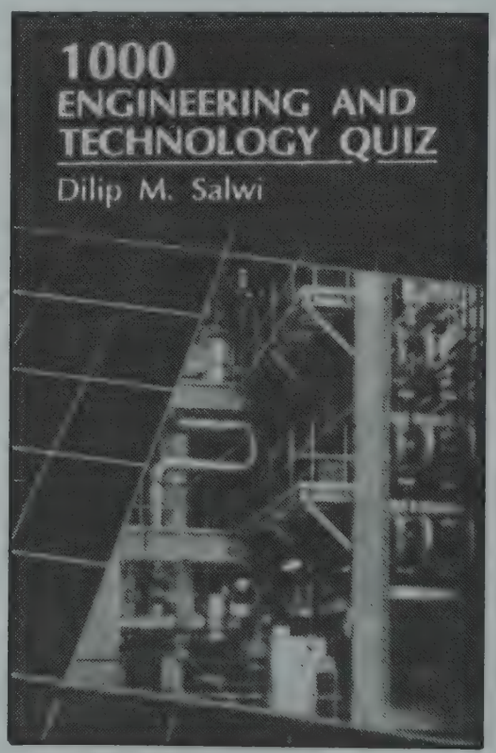
1000 ENGINEERING AND TECHNOLOGY QUIZ *by* Dilip M. Salwi, *Rupa & Co.*, 7/16, Ansari Road, Daryaganj, New Delhi-110 002, Pp. 146, Rs 30.00.

Both engineering and technology play a pivotal role in the growth and development of a modern civilisation and society. Technology is basically a tool to provide a particular solution to a problem with a view to meeting human needs and desires - be that the construction of bridges, dams, buildings, machines or setting up of industrial plants, etc. Every technology has in-built science. However success of a technology depends largely on specialised skills and techniques. It is here that engineering steps in. Engineering skills and expertise serve as driving force behind the success of any technology. So, engineering and technology, strictly speaking, are inseparable from one another.

The book under review includes 1000 quizzes on these two vital areas. Starting with the pioneering developments and inventions the book includes questions on various engineering tools, machines, devices, instruments, materials and various manufacturing and development processes. The book also highlights the role of engineering and technology in industry and in our daily life. Also, included in the book is a host of interesting questions relating to technical symbols, units and measures, drawings, important dates and events, etc. Indian contributions to engineering and technology are mentioned too.

Besides serving as tools engineering and technology have an all-encompassing effect on society as well. The book also deals with technology and societal relations and the politics of technology. Technology has penetrated art, literature and films too. Charlie Chaplin's satirical film *Modern Times* depicted, for instance, the dehumanising effects of factories and industries. Also, the celebrated literary figure William Blake called the newly established factories of the Industrial Revolution the 'dark Satanic mills'. A sci-fi masterpiece by Karel Capek titled *'Rossum's Universal Robots'* is a brilliant satire on the present industrial society. In another satire *'Erewhon'*, written by Samuel Butler, the machines have been banished from the world with a view to protect human freedom. All these things appear in the form of illuminating quizzes in the book.



Included in the book are some very interesting quotes on technology and engineering too. Take for instance, the following quote by Stuart Chase: "To condemn technology in toto is to forget gardens made green by desalination of sea water, while to idealise technology is to forget Hiroshima". Another noteworthy quote by Allan Mazur that appears in the book is, "When in doubt, reject the technology-better safe than sorry".

From curiosity point of view, the book has much to offer. It is interesting to note that the famous inventor of volcanized rubber, John Boyd Dunlop, was a veterinary surgeon by profession. Also, Samuel Morse, the inventor of telegraph, was an accomplished painter. An engineer named James Buchanan Eads was, incidentally, a financial wizard and banker. Besides, did you know what was the invention that was made in 1949 in just three hours, to pay a debt of $15? Also, were you aware that the steam engine was used for the first time in mining industry for pumping out flood waters from mines? The word 'Luddite' means an anti-technology person. But, do you know who this person was and what act of his led to the coinage of this particular word?

The topics covered in the book span a wide variety of things. From civil engineering angle the book includes questions on types of bridges, different kinds of foundations for bridges and buildings, various methods of construction of a sky-scrapper, materials needed for building massive structures, etc. Besides questions on metallurgical, chemical and mechanical engineering, those on medical technology and others also find place in the book. The book will be useful and valuable to anyone who wishes to acquaint oneself with the developments and advances made in engineering and technology. Those appearing for competitive examinations will also find the book highly rewarding.

P.K.Mukherjee

AT THE SPEED OF LIGHT, BOSE AND HIS STATISTICS and **CHANDRASEKHAR AND HIS LIMIT** *by* G Venkataraman, *University Press (India) Ltd.*, 3-5-820 Hyderguda, Hyderabad 500 029; Pp 126,123 and 134; Rs 40, Rs 35 and Rs 35.

Among all the sciences, physics is considered a dry subject meant for the serious lot. The three books of the series *'Vignettes in Physics'* make one question that notion. The series will initiate the novice in physics and motivate and encourage the vacillating to take up science in general and physics in particular. The three books are certainly unique in themselves, written as if on an inspiration and by an authority on the subject.

Every student of science has to learn about nuclear fission and fusion reactions in physics and then again exothermic chemical reactions as a part of chemistry. But nobody tells him that the same spirit of nature runs in both. In both the cases, mass gets converted into energy as per the celebrated Einstein's equation $E=mc^2$. Only difference is that in case of an exothermic reaction the mass lost is so minute that it is impossible to measure it. This is lucidly discussed in *At the Speed of Light*. There are other such examples, which demolish the barriers between the sciences, revealing the common secrets of nature.

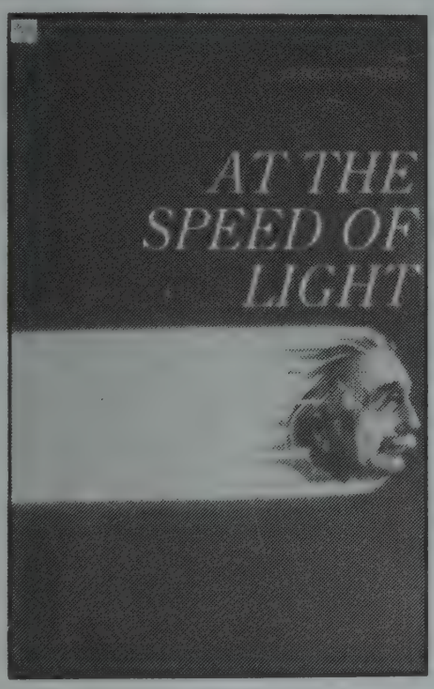
Starting with Newton's laws of motion, Galilean and Lorentz transformations, the author gives the historical development of physics, leading to the famous Michelson-Morley experiment (which shattered the then prevailing view of the existence of all pervading ether) and Einstein's Special Theory of Relativity. This book clarifies our concept of space contraction and time dilation and widens our horizon as to how objects travelling with speed close to that of light would look like. After explaining the various paradoxes in relativity, it throws light on the efforts made to unify the four fundamental forces of nature - gravitation, electromagnetic, weak and strong nuclear forces.

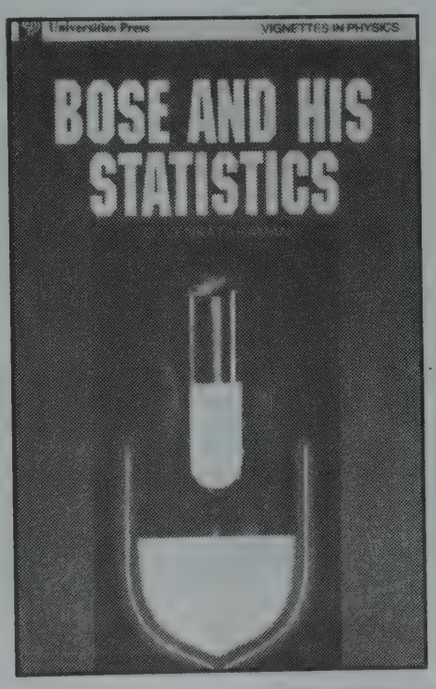
In *Bose and His Statistics*, the author puts in proper perspective the work of Satyendranath Bose vis-a-vis the work of other luminaries in modern physics, namely, J.J.Balmer, Wilhelm Wien, Max Planck, Niels Bohr, Albert Einstein, Louis de Broglie, Werner Heisenberg, Erwin Schrodinger and P.A.M.Dirac. Planck's concept of energy quanta and wave-particle duality of de Broglie led to the development of quantum mechanics. The author describes how Bose innocently treated photons to have two states of polarization and also assumed non-conservation of photon number, to arrive at the Planck's formula for blackbody radiation. In short, Bose laid to a part of the foundation for quantum statistical mechanics even before quantum mechanics was born! While describing Albert Einstein's Special Theory of Relativity, for which he is famous, the author mentions that he published two other monumental papers in 1905, one on photoelectric effect and the other on Brownian motion, each deserving a Nobel Prize. However, he got one only, on photoelectric effect in 1922.

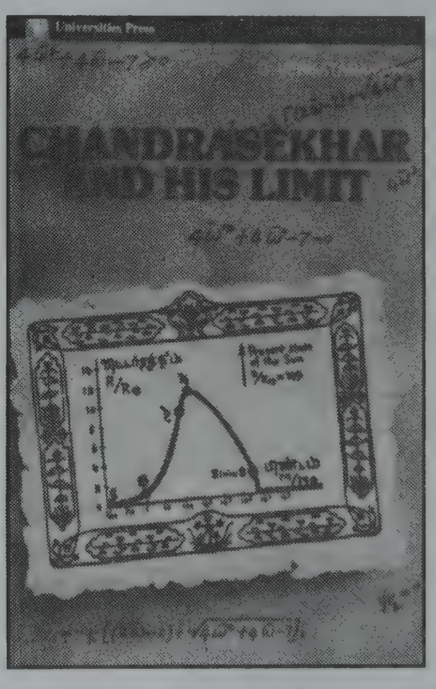
In *Chandrasekhar and His Limit*, the author beautifully portrays the story of creation of the universe, the Big Bang theory, how a star is born, how it ages and how it ultimately dies to form a white dwarf, a neutron star/ pulsar or a black hole. Most important of all, he puts in proper perspective how Chandrasekhar's contribution explains as to when a star ends up as a white dwarf or a neutron star depending upon its initial mass. The historical development of the subject starts with R.H. Fowler's contribution and Lane-Emden equation. Young Chandra modifies this equation and solves it to predict the formation of white dwarfs. Thereafter the story hots up with his encounter with the eminent astrophysicist Arthur Stanley Eddington in Cambridge and how his theory was ridiculed by the latter. .

Eminently readable, the books will stimulate a curiousity in the casual readers and encourage them to read on, but for the mathematics, which can however be left alone without breaking the rhythm of the story. For the serious students of physics these books will prove to be appetizers, stimulating hunger for more on the subject.

Tarun Banerjee







GINSENG IN INDIA

IT is the other name for the "Wonder drug from China". The root of Ginseng, which forms the drug, has been used in China for atleast 4000 years, and is a famous remedy among the Chinese from time immemorial; they have ascribed extraordinary virtues to it. Ginseng is regarded as alterative, antiseptic, anodyne, aphrodisiac, cardiotonic, carminative, demulcent, diuretic, emetic, estrogenic, expectorant, gonadotrophic, nervin, sedative, sialogogue, stimulant, stomachic, tonic, and tranquilizer, to list a few of its uses. It is used in amnesia, anemia, anorexia (loss of apetite), apertif (alcoholic appetizer), asthma, atherosclerosis (deposition of fats and calcium in veins), boils, bruises, cachexia (general ill health and malnutrition), cancer, convulsions, cough, debility (loss of strength), diabetes, dysentery, painful menstruation, and so on, in many common ailments.

No wonder it forms an important economic plant in international trade. Approximately three fourths of the income of Korean export is from ginseng. In the U.S. ginseng is one of the biggest herbal exports exceeding 35 million dollars worth per year. India imports ginseng from trade centres like Indonesia and Singapore and in a single month of March 1992 has imported 45,688 kg of ginseng to the tune of Rs. 6,77,248 lakhs.

China, Korea and Russia have been known to be the original home of this plant, popularly called the "Asiatic or Chinese" ginseng. Therefore, it is a matter of great significance to India to know that it has recently been found to occur in our country.

Botanists of the North Eastern Hill University, Shillong, have stumbled upon this wonder plant during their recent plant exploration in Nagaland. They found this plant—about 60 cm tall, having 5 to 6 lobed leaves, bearing greenish-white flowers and crimson-red, kidney-shaped fruits—growing wild as forest undergrowth, between 1800 m - 2,500 m above mean sea level in Saramati, Yakko, Chentang, Changsang forest ranges in Tuensang district.

It is possible that this plant might have been existing since long, but went unnoticed due to the inaccessibility of the area of its occurrence.

The Asiatic or Chinese ginseng is botanically known as *Panax ginseng* Meyer (*P. schinseng* Nees) the first name *Panax* being a derivative of Latin words *pan* - meaning 'all' and *axos* - meaning 'cure'. Thus *Panax* means 'Cure-all'. The second epithet *ginseng* is derived from Chinese words. Etymologically, the sound *gin* stands for the Chinese word for 'man' and *seng* is the equivalent of 'essence', the substance that underlies all outward manifestations.

Four different plant species related to the commercial ginseng, are commonly found in India *P. bipinnatifidus, P. burkillianus, P. pseudoginseng and P. sikkimensis.* Of these *P. pseudoginseng* is a potent medicine, which is also being cultivated in China for over 2000 years, and has some of the attributes of the Asiatic ginseng. In China, the medicinal product of this plant, known as *Sanchi* is being used for treating various ailments including cancer.

Pharmacological investigations show that the basic effect of ginseng is to increase the non-specific resistance and defence mechanism of the body.

China and Korea have been the only known sources of the commercial ginseng. Due to over-exploitation, the supply of ginseng has rapidly dwindled. As the supply started dwindling, the root obtained in America from a related species - *Panax quinquefolium* - known as American ginseng, having almost identical properties as the Asiatic ginseng, is now being used to a large extent in modern medicine.

Ginseng is marketed in several different forms such as tea powder, drink, liquor, capsules and confectionery. In order to cope up with the increasing demand, a poor indigenous substitute, for ginseng *'Ashwagandha' (Withania somnifera)* is being used in pharmaceutical preparations in our country.

The rapid increase in market demand for ginseng has encouraged its cultivation in Korea, China, Japan, Russia and America where the ginseng has natural habitation. And now, with the report of the occurrence of

the Asiatic or Chinese ginseng in India, possibility of raising germplasm banks from its wild resources presents itself. Botanists who have reported the occurrence of this plant in Nagaland have cautioned that it is already being exploited indiscriminately and smuggled into Burma and China. Therefore, cultivation of the Asiatic ginseng in and around its place of occurrence will have bearing on the economics of imports vis a vis foreign exchange.

For prospective growers of ginseng in India, the following hints on cultivation practises may be helpful. Suitable conditions for ginseng cultivation in India could be created similar to those of its natural habitat. A favourable location on a slope facing North or North-East, or in the plains having good drainage, with the annual winter and summer average temperature around 9 ° to 13.8°C and 20° to 25°C, and annual and optimum precipitation of 700 to 2000 mm and 1,100 to 1,300 mm respectively, are preferable for ginseng.

Ginseng plants prefer shady conditions and shading of normal sunlight is required to received the optimum light intensity. suitable soil with a large amount of available potassium, and sandy loam in the upper layer and clay in the deep layer and a pH value of 5.5 to 6 are good for its cultivation. However, soil treated heavily with chemical fertilizers and concentrated manures are not advisable. The soil must be turned over to greater depth more than 10 times from the month of May to late September. Application of 60-70 tonnes of wild grass per hectare to newly reclaimed soil, and upto 40 to 60 tonnes to a cultivated one, is recommended.

Nursery and permanent beds should be made in late October. the ripe red fruits are collected from the four-year old plants in july. The seeds are removed from the berries, washed and dried to open the shells as early as possible after gathering, and stratified soon after, with gibberellic acid over a period of 24 hours.

A nursery bed is made by a combination of virgin soil with sand in late October. In early November, the seeds are sown in at a depth of 2.5 cm. artifical shade musat be built over the nursery beds in mid-April when about 30% of germination is completed. In mid-May, addition of soil would ensure adequate supply of nutrients and prevent lodging. In late October, withered stems and leaves are removed and furrow soil must be put into the bed. The seedlings are dug up after removing soil from the beds early May the following year. Seedlings should be selected and put in a closed box and kept in a dark and cool place until planting.

Seedlings are then transferred to permanent beds for three to five years. The seedlings are generally transplanted during late March and early April at the optimum rate of 10 to 12 seedlings per square metre. In the fall of the fourth growing season when the fruits have turned red and shoots have become yellow, the roots are dug, using a potato digger, between July and October.

The fungal diseases can be controlled through proper maintenance and through transplantation of the seedlings on to new beds several times during the period of their development. The first transplanting is done when the plantings are two years old. Regulation of the environment, especially of soil humidity and aeration and of illumination are very important factors in the ginseng disease control.

Hybridation and genetic improvement with other related species of ginseng in India enumerated above, are a distinct possibility and would yield better results in its cultivation and use. Especially, *Panax burkillianus* Bennet & Viswanathan, occurring gregariously as undergrowths in the Upper Shillong forests, and having a better survival and reproduction rate than the others, may prove to be a valuable source for the genetic improvement of the commercial ginseng.

M.V. Viswanathan, H.B. Singh and P.R. Bhagwat are with Publications & Information Directorate, Dr. K.S. Krishnan Marg, New Delhi-110012

DAMP PROOF HOUSES

R. S. MALIK
B. S. SANGWAN

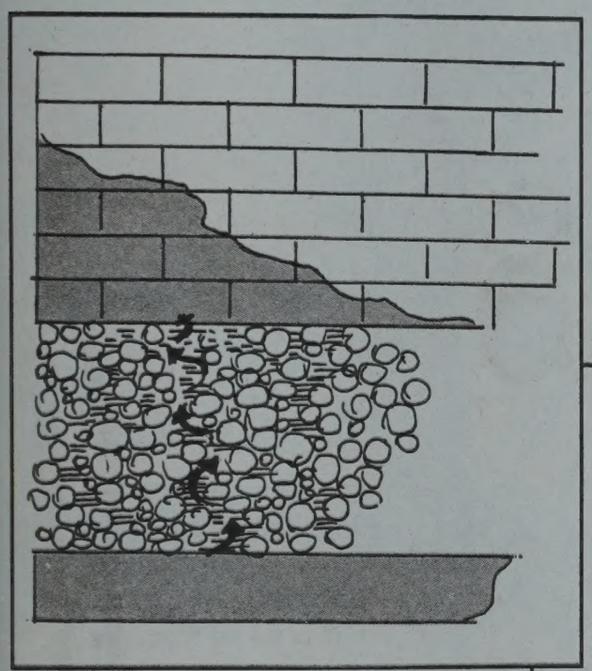
SALT and water seepage from wall surfaces is very common in arid and semi-arid regions. Such condition is generally termed as dampening. Dampening to 3 to 4 meters height on walls of building, is a common sight in regions where the underground water is pretty near the surface. The dampening is caused by the rise of water through the pores present in soil and in bricks from the shallow ground water table — a phenomenon called capillary rise. Its subsequent evaporation at the surfaces of floor or walls leaves behind large quantities of salts in the form of white encrustation.

Dampness causes losses to building structures. It increases humidity in the houses, and also the population of insect pests. Along with it comes many human and animal infections and allergic diseases which make the environment more suffocating and unhealthy. In addition to spoiling the living environment dampness and surface salt accumulation also cause disintegration of bricks and the cementing materials. It peels off cement plasters on wall and floor surfaces defacing and discoloring the walls. In most of the cases moistening of the base of the building results in cracks in walls and floors of the building. It is, therefore, important to make houses damp-proof.

Ground water will rise to different heights depending upon the texture of the soil. Texture refers to the particle size distribution. Examples of light, medium and heavy textured soils are: sand, sandy loam and silty clay. The nomenclature of light and heavy textures infact is taken from the magnitude of force needed to work with these soils. It is easier to work in light textured soils and they have comparatively large (around 0.015 mm) pores. Therefore, the rise of water is also very less, may be to a maximum height of one metre. The height to which water rises could be 5 m in sandy loam and 7 m in silty clay. It is, therefore, desirable to construct houses on sandly soil to prevent damp threat from shallow ground water table. The extent of dampening also depends upon the amount of water that is rising from the ground water to the soil surface, in other words upon the depth to water table. It decreases abruptly with increasing depth to water table. It means dampness threat is high in areas near canals where water table

remains generally at shallower depth. Presence of salt either in ground water or in soil will further aggravate the dampness problem by creating salt encrusations at the wall or floor surfaces of the buildings. In such situation it becomes all the more important to make damp-proof houses.

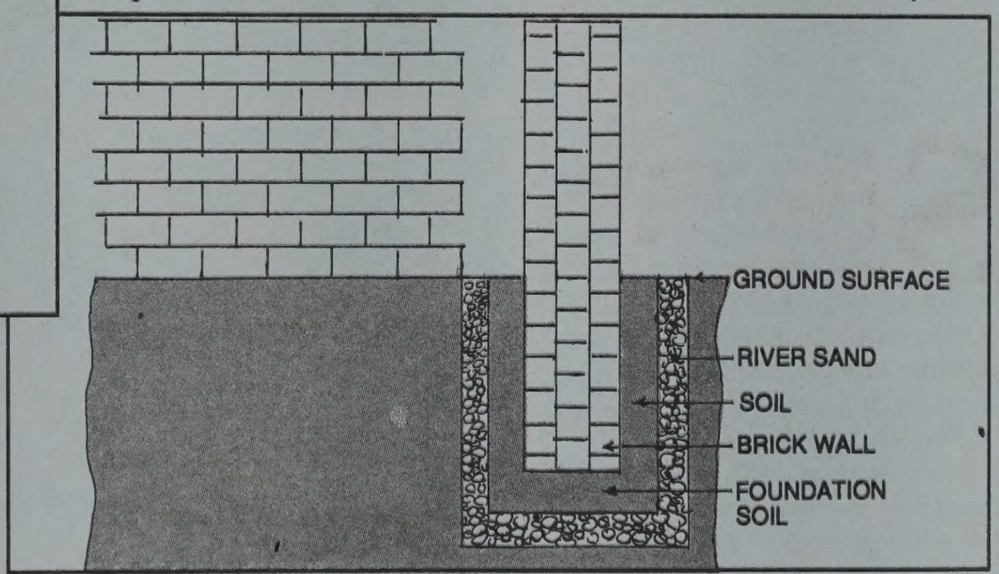
There are many ways to make a house damp-proof. Black tar is painted as a thin coat at the bottom of the walls over a concrete layer. This is an effective and durable method of damp-proofing. However, it is costly operation. Its effectiveness is low in *Kacha* walls because tar paint can remain effective for longer periods only on smooth, hard and stable surfaces. Therefore, it is useful only over a concrete layer in 'Pucca' houses.



Water rises through pores in the soil

Cement polishing is done on concrete lined floors of the houses with a special cement mixture with the help of smoothening and polishing machines. This is also an effective and durable method of damp proofing the concrete floors of 'Pucca' houses. However, its cost is also very high.

Polythene lining is the third method. In this case, Polythene sheet is lined at the bottom of floors and of walls of *Kacha* and *Pucca* houses. It is also an effective method of damp proofing. However, its durability is reduced many-a-times by scratches and punctures. An alternative to all these is that of sandwitching a sand-layer or the sandwitch technique. The sandwitch technique consists of putting a 5 cm thick layer of coarse river sand 10 cm below the surface soil. Sandwitching operation under *Kacha* or *Pucca* floor is done in sequential steps. First the upper 15 cm of original soil is removed and the sand is spread uniformly in a 5 cm layer. It is then covered with a layer, atleast 10 cm thick, of salt. Sandwitching operation under the walls starts from a level where the base of foundation of the wall is placed in three sequential steps as outlined under floor sandwitching. It has been found that coarse sand layer placed between two layers of comparatively finer textures is more effective in checking salt and water seepage than a simple, single textured sand filling. The damp does not rise through the sandwitched sand layer even after 10 years of operation. In addition acting as a bnarrier to the rising water the sand layer also acts as a cushion absorbing the shock of compression of soil under the building.

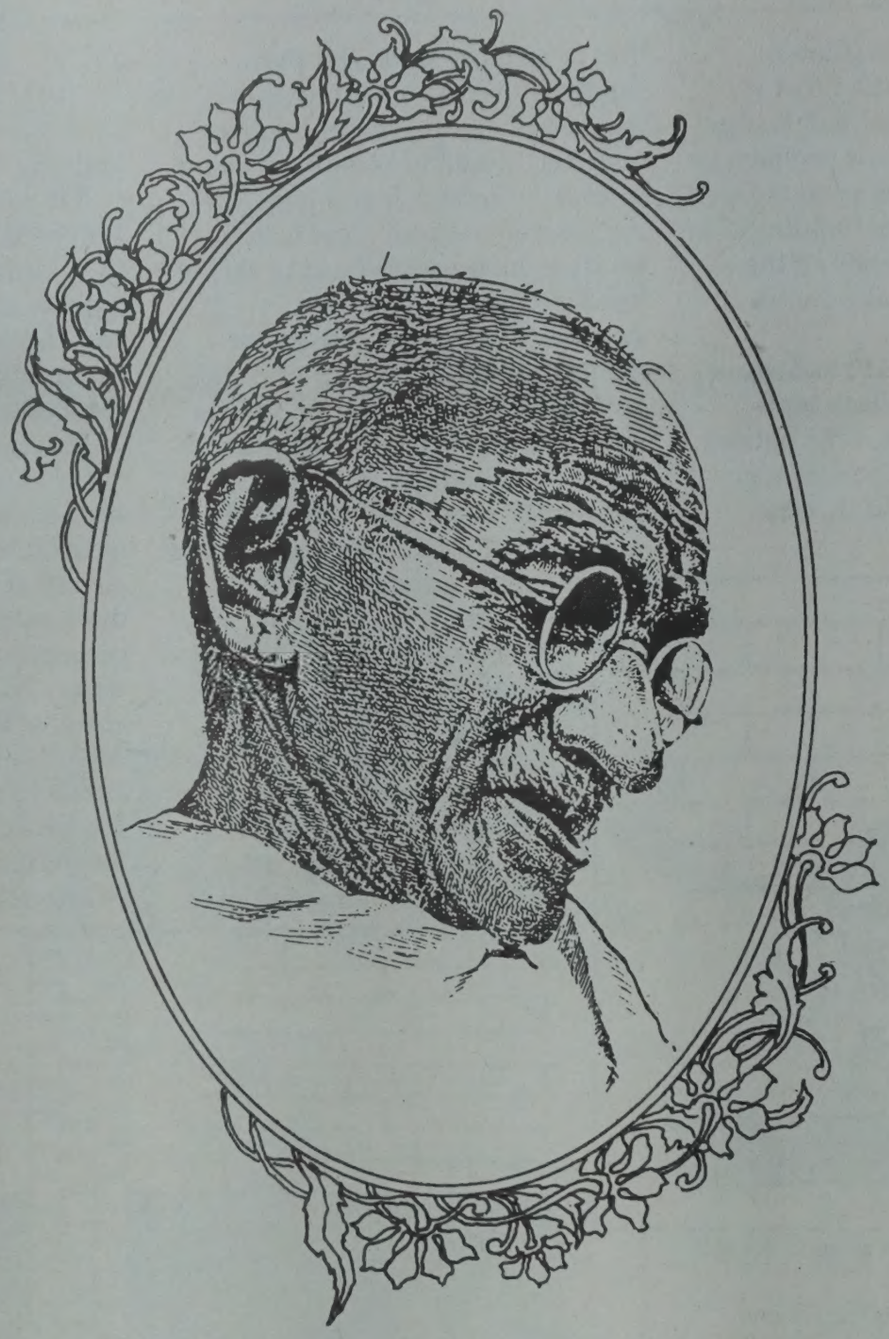


Sandwiching sand between two soil layers prevents the rise of water

Tar painting and cement polishing check the capillary rise of water to the surfaces by reducing the number of water transmitting pores and also by making the tarred surface non-wettable. Polythene sheet blocks all pore through which water can rise from the ground water to the soil surface or wall surface. In case of sandwitch technique, the comparatively large air gap at the interfaces obstructs the movement of water thus preventing to the capillary rise of water. Nevertheless, sand layer is effective in breaking the capillary rise of water only when it is situated atleast 70 cm above the water table. It is because the continuity in water filled pores of different textured soils in contact breaks normally when the soil water suction is more than 70 cm of water column.

Sandwitching technique needs river sand which is available cheap in many parts of India. The technique can be accomplished even by unskilled persons. It can be used in preventing and checking salinization in kitchen gardens also.

Dr S. Malik and Sangwan are professors at the Department of Soil Science, CCSHAU, Hisar-125004



My life is my message

- Mahatma Gandhi

On the solemn occasion of Gandhi Jayanti (October 2, 1993), let us renew our commitment to follow the path of truth, non-violence, universal brotherhood, equality and progress shown by Bapu.

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संघ एवं राज्य लोक सेवा आयोग की प्रारम्भिक एवं मुख्य परीक्षाओं के लिए विशेष

परीक्षोपयोगी सीरीज-1
भारतीय अर्थव्यवस्था
(पूर्णतः संशोधित एवं संबर्द्धित)
मूल्य : 40/-

परीक्षोपयोगी सीरीज-2
भूगोल
(भारत एवं विश्व)
मूल्य : 40/-

परीक्षोपयोगी सीरीज-3
भारतीय राजव्यवस्था
मूल्य : 40/-

परीक्षोपयोगी सीरीज-4
भारतीय इतिहास
मूल्य : 40/-

अपने निकटतम पुस्तक विक्रेता से खरीदें अथवा
पूरा मूल्य मनीऑर्डर द्वारा भेजकर पत्रिका मँगाएं

प्रतियोगिता दर्पण
2/11 ए, स्वदेशी बीमा नगर, **आगरा– 282 002**
फोन : 53276, 51002 फैक्स : (0562) 53205